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Study on Variation of Proximate Composition and Trimming Loss of Age and Sex Variable Hilsa (*Tenualosa ilisha*) in Bangladesh

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Abstract: A study on variation in proximate composition viz., moisture, protein, fat and ash content and trimming loss during processing of hilsa (*Tenualosa ilisha*) was conducted to investigate the variability within the changes of age and sex. Male, female brood, female spent (post spawning) and jatka (juvenile hilsa<23 cm) were collected and whole-body weight, carcass weight, yield of offal were determined. Among the losses, viscera percentage was always found maximum in every size and sex of hilsa. Dressing percentage was highest for brood hilsa followed by male hilsa. External losses included the loss of head, scales, fins and gills. Maximum losses were found in brood fish which was 40.54% where visceral loss was 17.59% and other external loss was 22.95%. In male, spent and jatka hilsa 37.32%, 35.89% and 31.67% loss were recorded where visceral loss was 16.29 %, 15.04% and 12.42% and external loss was 21.03%, 20.85% and 19.25% of whole-body weight of fish. Protein content ranged from 13.15 to 18.54% with the lowest in jatka and the highest protein content in brood. Lipid content ranged from 6.90 to 15.58% with the highest lipid content in brood and the lowest in jatka. The ash content of whole hilsa was found 0.96, 1.08, 0.90 and 0.85% in male, brood, spent and jatka respectively. Moisture in whole hilsa in this study was found to be the main component ranging from 64.04 to 77.88% with the highest moisture content in jatka and the lowest in brood and 67.33 % in spent followed by 65.15 % in male hilsa. In this study the protein, lipid, ash and moisture content of male, brood, spent and jatka head, fore part, middle part, hind part and viscera were determined. Hilsa eggs were found nutritionally rich and showed to contain 63.32, 15.16, 17.06 and 2.75% moisture, protein, lipid and ash respectively. In conclusion, it can be said that proximate composition and trimming loss of hilsa samples were varied mostly at adult hilsa and jatka.

Key words: Proximate Composition · Hilsa · Trimming Loss · Variable

INTRODUCTION

Bangladesh is one of the world's leading fish producing countries with a total production of 46.21 lakh MT in FY 2020-21, where aquaculture accounts for 57.10 percent of the total fish production [1]. Fisheries sector of the country plays an important role to socioeconomic development [2-7]. According to FAO report The State of World Fisheries and Aquaculture 2020, Bangladesh ranked 3rd in inland open water capture production and 5th in world aquaculture production. Bangladesh is ranked 1st among 11 hilsa producing countries in the world. The national fish hilsa (*Tenualosa ilisha*) as a single species has been making the highest contribution (12.23 percent) with 5.65 lakh MT total production in FY 2020-21. Geographical Indication

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Registration Certificate has also been achieved for our national fish hilsa named as 'Bangladesh ilish' [1]. Hilsa (*T. ilisha*) which is very much popular for its unique taste and nutritive value due to its distinctly soft oily texture. It is a dark fleshed fatty fish. This commercially important open water fish species is found in the major rivers, estuaries and the Bay of Bengal in Bangladesh. Major catch of hilsa (about 95%) comes from Bangladesh, followed by India and Myanmar. Generally, about 60-70% hilsa are consumed fresh and the rest are exported to USA, EU, Japan and the Middle-East [8].

Hilsa is preferable and nutritionally unique because of having polyunsaturated fatty acids (PUFAs), especially omega-3 PUFAs which are considered significant in curing cardiovascular and other important human diseases [9]. The hilsa is largely an anadromous species whose normal habitat is the lower region of the estuaries and the foreshore areas ascend the rivers during the breeding season and return to the original habitat after spawning [10]. Hilsa from riverine catch is considered to be tastier than those from marine catch [8]. There might be variation in nutrients such as proximate composition between marine and riverine catches during pre and post spawning (mature/young and spent) condition. Precise information on biochemical composition is useful not only for developing nutrient-balanced, cost-effective human diets, but also for the purpose of post-harvest processing and storage of hilsa and hilsa products for their export. Although several studies on the biochemical composition of many commercially important fishes have been reported from many countries, very limited systematic investigation had so far been made on the nutritive values and biochemical composition of the hilsa stock of Bangladesh.

The assessment of the proximate composition of the fish is not only important to know its nutritive value, but also for its better processing and preservation [11]. Carbohydrates and non-protein compounds are also important constituents but are present in small amounts and are usually ignored during analysis [12]. Proximate composition varies with diet, feed rate, genetic strain and age [13]. The nutritional composition of fish varies greatly from one species to another, depending on age, feed intake, physical activity, sex and sexual changes connected with spawning, the environment or geographical localities and season [14]. Their values however, vary considerably within and between species and also with size, sexual condition, feeding, time of the year and physical activity [15]. Carcass traits of hilsa are also good indicator of edible and inedible yield that can be easily and conveniently determined [16]. Study of physical structure of fish is important in order to understand the nutrition profile and quality changes of fish. In carps and catfishes, the carcass yield and dressing percentage is significantly addressed by the weight of the head and viscera. Rare information found about inedible part assessment of hilsa. The final dressed yield (%) of hilsa fish (edible) depends upon the inedible portion which includes of head, scales, fins, visceral content and slime weight of fish that makes a significant loss of nutrients of the fish. This type of loss in hilsa must be accounted as great loss. Therefore, determination of such loss of nutrients through inedible portions of the body should also be known. The present study was undertaken to investigate the variation in proximate composition of hilsa (*T ilisha*) fish (both edible and inedible portion) of different size and different sex and also determine the physical proportions of hilsa at different stages to characterize the carcass traits of different size hilsa (*T ilisha*).

MATERIALS AND METHODS

Sample Collection: Fish samples were collected from local fish market of Mymensingh, then immediately transported to the fish processing and quality control laboratory of fisheries technology department at Bangladesh Agricultural University, Mymensingh.

Collection Time and Numbers: Four (4) individuals each of male & female brood hilsa during (September-October), 4 individuals of spent/post-spawning female hilsa and10 individuals of juvenile/jatka (March- April) less than 23 cm sizes were collected.

Sample Preparation: Samples from different parts of hilsa for study were taken in separate sample bottle by chopping into smaller pieces by sharp knife and then homogenizing by blender for proximate composition.

Physical Proportion Measurement: Whole body weight, carcass weight, weight of viscera was determined following a standard carcass evaluation technique. Different portions of trimmed parts were weighted separately for calculating the percentage of total body weight and were termed as inedible parts. For measuring the composition of fish at its different body parts (edible), each of the gutted/dressed hilsa fish were then segmented into parts as fore part, mid part hind part. Samples were stored in a fridge (-18 to -20 °C) until performing proximate composition analysis [17].

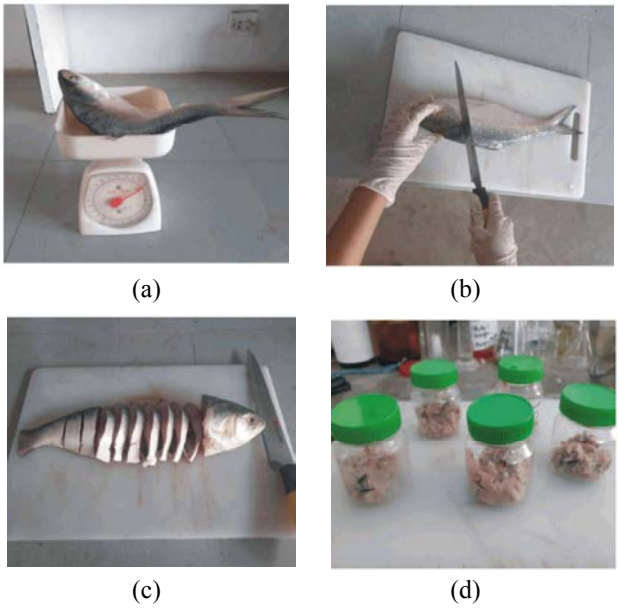

Fig. 1: Sampling procedure (a) weighting of fish sample (b) Dressing (c) chunk of hilsa and (d) Kept in sample bottles

Proximate Composition Analysis: The four major constituents in the edible portion and other inedible portions of fish were analyses moisture, protein, lipid (fat or oil) and ash (minerals). The proximate composition analysis of the samples of different parts of the body was analyzed according to the method of AOAC [17]. For each analysis of proximate composition, triplicate samples were used.

Data Analysis: All the recorded data was accumulated and analyzed by MS Excel and SPSS software (version 16.0) to find out the mean and standard deviation.

RESULTS AND DISCUSSION

The relationships of various dressing losses and dressed fish weight with total fish weight were worked out and presented (Table 1). The losses during the dressing of fish were corresponded directly to their total body weight. The total losses were 39.33% and total yield was 60.67% after processing.

The mean total body weight of brood hilsa was found 1242.34±6.3g (Table 2) which was higher than the mean body weight of male hilsa. The mean dressed fish weight was 738.51±13.7g or 59.54% of the total weight of whole fish. The total losses were 40.46% which was little higher than male hilsa. A significant dressing weight loss in head was found to be 16.25% although some people consider the head as a delicious edible item in the food menu.

The final percent dressed yield and dressed losses of spent hilsa presented in table-3 which was 61.21% and 38.79% respectively.

In case of Jatka showed on (Table 4) the yield and dressing percentage is significantly addressed by the weight of the head and viscera. The total dressed losses were 31.69% where head and viscera occupied 24.71%. So there existed highly significant and positive correlations between various dressing losses, dressed fish weight and total fish weight of hilsa.

Carcass traits (dressed loss, inedible) as shown in the above tables are good indicator of edible yield. Dressing percentage was highest for brood hilsa followed by male hilsa. This was due to higher weights of external losses in brood fish as compared to other weight categories of male, spent and jatka. Losses in different portions of, percentage of visceral and external weights with total body weight in age and sex variable hilsa were presented in (Table 5) where maximum losses occur in brood fish which was 40.54%. External losses included head, fins, gills and scales. In male hilsa 37.32% loss occurred where visceral loss was 16.29% and external loss was 21.03% of total weight of fish. 35.89% loss occurred in case of spent hilsa where visceral loss was 15.04% and other total external loss was 20.85%. In jatka 31.67% loss occurred and visceral loss was 12.42% and external loss was 19.25% of whole-body weight. A study by Sahu *et al.* [16] observed carcass characteristics of hilsa and found 58.7% of the total yield and total loss 41.3% where viscera

Table 1: Experimental fish and its different trimmed/ dressed portions of mature male hilsa (*T ilisha*)

	Male Hilsa (*Tenualosa ilisha*)	
Weight of fish and its dressed portions (g)	Mean weight (g) (n=4)	Mean percent of body weight %
Total body weight	836.23 ± 12.6	100.00
Weight of Scales	21.41 ± 1.3	2.57
Weight of fins	11.62 ± 1.2	1.39
Weight of head	134.34 ± 4.7	16.06
Weight of gills	25.18 ± 1.4	3.01
Weight of Viscera	136.30 ± 2.3	16.29
Dressed fish weight	507.38 ± 11.7	60.67

Table 2: Experimental fish and its different portions of the body of mature female brood hilsa (*T. ilisha*)

	Brood Hilsa (*Tenualosa ilisha*)	
Weight of fish body and its dressed portions (g)	Mean weight (g) (n=4)	Mean percent of total body weight %
Total body weight	1242.34 ± 16.3	100.00
Weight of scales	32.78 ± 3.1	2.65
Weight of fins	15.63 ± 2.4	1.27
Weight of head	201.93 ± 5.8	16.25
Weight of gills	34.87 ± 2.5	2.80
Weight of viscera	218.62 ± 4.4	17.59
Dressed fish weight	738.51 ± 13.7	59.54

Table 3: Experimental fish and its different portions of the body of spent female hilsa (*T. ilisha*)

	Spent Female (Post-spawning) Hilsa (*Tenualosa ilisha)*	
Weight of fish body and its dressed portions (g)	Mean weight (g) (n=4)	Mean percent of total body weight %
Total body weight	702.52 ± 10.8	100.00
Weight of fish scales	16.58 ± 0.94	2.35
Weight of fish fin	8.14 ± 0.88	1.15
Weight of fish head	121.48 ± 2.20	14.48
Weight of fish gills	20.16 ± 0.98	2.87
Weight of fish viscera	105.69 ± 1.70	15.04
Dressed fish weight	430.07 ± 8.4	61.21

Table 4: Experimental fish and its different portions of the body under study juvenile hilsa (*T. ilisha*)

	Juvenile/ JatkaHilsa (*Tenualosa ilisha*)	
Weight of fish body and its trimmed portions (g)	Mean weight (g) (n=10)	Mean percent of total body weight %
Total body weight	199.53 ± 6.8	100.00
Weight of scales	4.82 ± 0.73	2.39
Weight of fin and tail	3.01 ± 0.65	1.52
Weight of head	25.13 ± 3.4	12.29
Weight of gills	5.48 ± 0.21	2.75
Weight of viscera	24.79± 1.8	12.42
Dressed fish weight	136.30± 5.6	68.31

Table 5: Losses in different portions of percentage of visceral and external weights with total body weight in age and sex variable hilsa (*T. ilisha*)

		Dressed Fish					
Types of Fish	Total Body Weight (g)	Weight (g)	Mean % of Body Weight	Mean Fresh Fish Total Loss(g)	Mean visceral % of Whole Body Weight	Mean External Loss % of Whole Body Weight	Mean % Loss
Male	836.23±12.6	507.38±11.7	60.67	328.85±10.5	16.29	21.03	37.32
Brood	1242.34±16.3	738.51±13.7	59.44	503.83±14.8	17.59	22.95	40.54
Spent	702.52±10.8	430.07±8.4	61.21	272.45±9.4	15.04	20.85	35.89
Jatka	199.53±6.8	136.30±5.6	68.31	63.23±5.9	12.42	19.25	31.67

loss was 17.9% and other external loss was 23.4. On the other hand, Raghunath *et al.* [18] determined the carcass quality of an endemic carp *Hypselobarbus pulchellus* where its offal and head comprised 26 and 10% respectively.

Proximate Composition Analysis of Age and Sex Variable Hilsa: Protein, lipid, ash and moisture of whole fish, head, fore part, middle part, hind part of the body and viscera of male, brood female, spent and jatka hilsa is graphically shown in Figure 2, 3, 4 and 5 respectively.

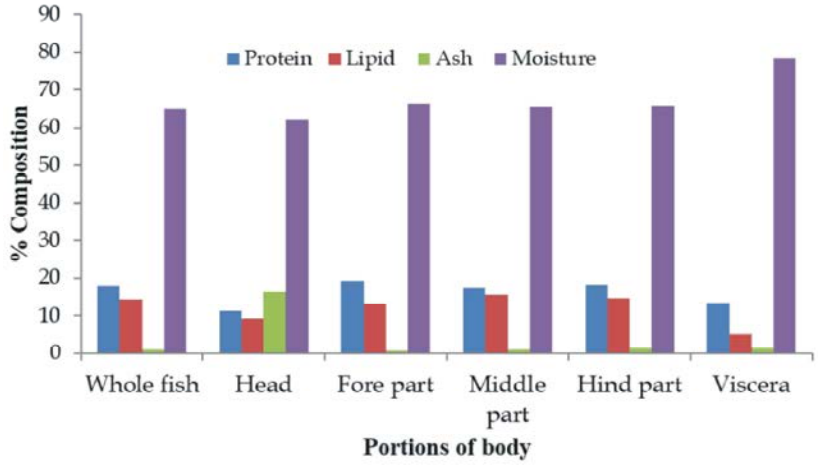

Fig. 2: Comparison of proximate composition of different portions of male hilsa (*Tenuolosa ilisha*)

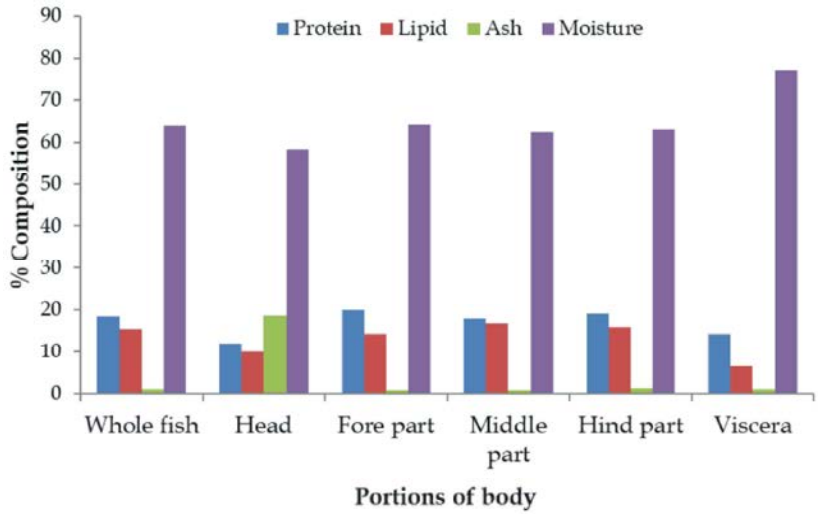

Fig. 3: Comparison of proximate composition of different portions of mature brood hilsa

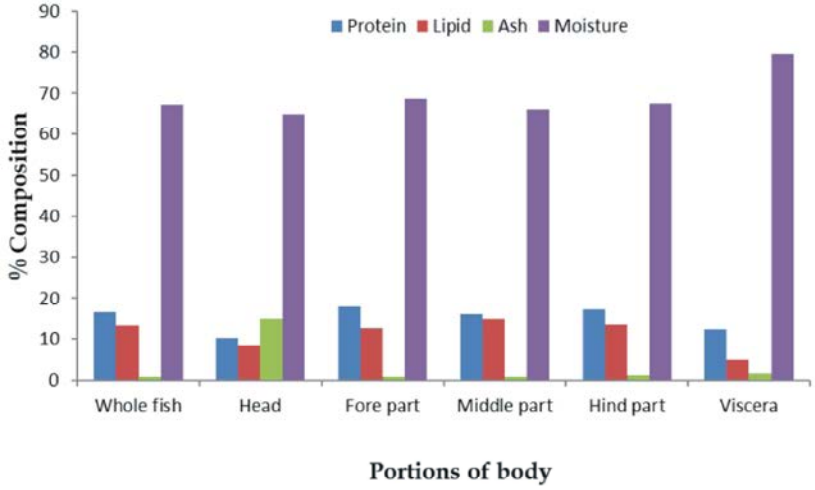

Fig. 4: Comparison of proximate composition of different portions of spent female hilsa

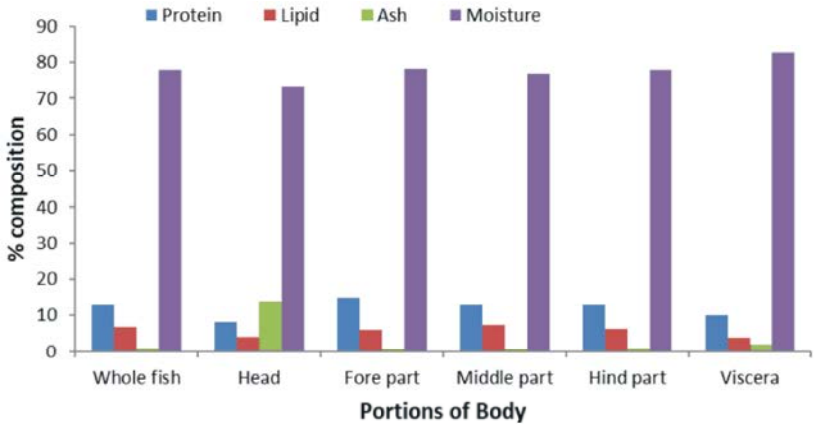

Fig. 5: Comparisons of proximate composition of different portions of juvenile hilsa/jatka

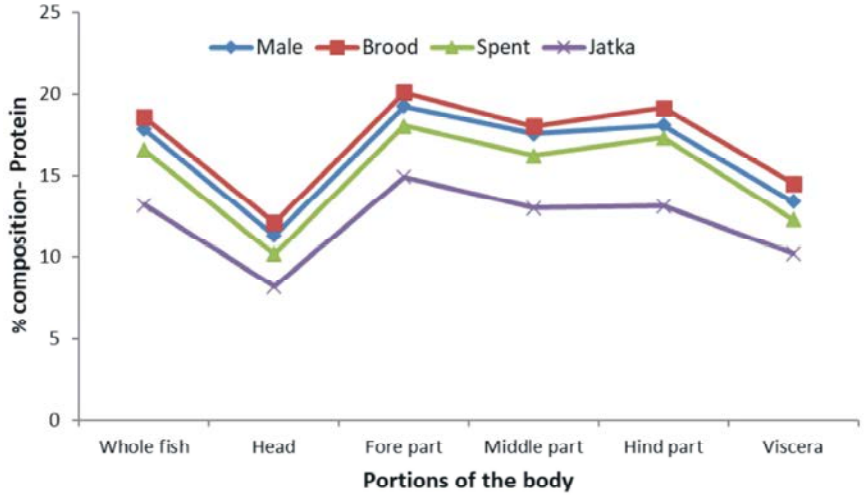

Fig. 6: Variations in protein content at different portions of age and sex variable (male, brood female, spent and juvenile) hilsa

Changes in Protein Content: Protein content in different portions on different categories (male, brood, spent and juvenile) of hilsa presented in Figure 2. Present study found that protein content ranging from 13.15 to 18.54% with the lowest in jatka and the highest protein content in brood respectively. 16.55, 17.82%protein was found in spent and in male hilsa respectively. In this study the protein content of male, brood, spent and jatka head was found 11.30, 12.10, 10.13 and 8.17%respectively.

On the other hand, the protein content of male, brood, spent and jatka of fore part had 19.23, 20.08, 18.03, 14.89%, middle part 17.55, 18.01, 16.22, 12.96% hind part 18.08, 19.12, 17.29, 13.09% and viscera 13.36, 14.49, 12.26 and 10.16% (Figure 2) respectively. A study conducted by Sahu *et al.* [16] observed carcass characteristics of hilsa where adult hilsa weight 810.5±32.1 g contains 18.1±1.95%protein in fore part, 19.6±1.4% protein in middle part and 21.8±1.4% in hind part.

Shamim *et al.* [10] reported proximate composition of different portion of hilsa where protein content was estimated as 20.56, 21.89, 20.29% in dorsal portion, ventral portion and caudal portion. The highest value was found in ventral portion and lowest value recorded in caudal portion of fish. In another study Hossain *et al*. [19] reported proximate composition of hilsa from Bay of Bengal and Arabian Gulf where protein content is higher (19.13±0.08) in hilsa from Arabian Gulf and protein content is lower (18.16±0.06) in hilsa from Bay of Bengal. Moniruzzaman *et al*. [9] study on nutritional value of spent and gravid hilsa where protein content was higher in gravid hilsa 19.44 ± 0.16 and lower in spent hilsa 17.09 ± 0.44. The gain of protein may occur for changing their habitat as well as feeding habit.

In another experiment Dewan *et al*. [20] recorded proximate composition of different size group of hilsa where protein content ranged from 17.61 to 18.55% with

the highest value in adult and the lowest in jatka. It was also found that the protein content was highest (18.23) in white muscle and lowest in viscera (14.27). Debnath *et al.* [21] observed nutritional value of hilsa and reported that crude protein was relatively higher (19.54± 0.47%) in the abdominal region and the lower (11.21 ± 0.51%) in the head region.

Changes in Lipid Content: The changes in lipid content in different portions on age and sex variable (male, brood, spent and juvenile) hilsa presented in Figure 7. Present study found that lipid content ranging from 6.90 to 15.58% with the highest lipid content in brood and the lowest in jatka.

The lipid content was increased gradually with increasing the size of fish. In this study the lipid content of male, brood, spent and jatka head was found 9.23, 10.09, 8.27 and 4.08%, respectively.

On the other hand, the lipid content of male, brood, spent and jatka of fore part had 13.25, 14.47, 12.52, 5.97% middle part 15.77, 16.99, 14.89, 7.48% hind part 14.55, 15.89, 13.41, 6.26% and viscera 5.16, 6.62, 4.88 and 3.98 %, respectively.

Shamim *et al*. [10] reported highest value of fat content was recorded in ventral portion of fish body (20.28%) and the lowest was in dorsal portion of fish body (18.65%). Another study by Hossain *et al*. [19] with hilsa from Bay of Bengal and Arabian Gulf where lipid content was lower (11.22±0.17%) in hilsa from Arabian Gulf and lipid content was higher (19.94±0.23%) in hilsa from Bay of Bengal. Moniruzzaman *et al*. [9] study on nutritional value of spent and gravid hilsa where he reported lipid content was higher in gravid hilsa (14.33 ± 1.29%) and lower in spent hilsa (14.43 ± 1.55 %).

In an experiment Dewan *et al.* [20] determined different size group of hilsa where lipid content ranged from 9.37 to 16.15% with the highest value in brood and the lowest in jatka. The lipid content was highest in dark muscle 14.53% and lowest in viscera which was 5.05%. Debnath *et al.* [21]observed nutritional value of hilsa and reported that highest fat content was found in the abdominal region of hilsa (16.41± 0.46%) and the lowest value was in the head region of hilsa (9.04 ± 0.45%).

Changes in Ash Content: The changes in ash content in different portion on sex variable (male, brood, spent and juvenile) hilsa presented in Figure 8 where the ash content of whole composition of hilsa was found 0.96, 1.08, 0.90 and 0.85%, respectively in male, brood, spent and jatka. In this study the ash content of male, brood, spent and jatka head was found 16.44, 18.69, 14.5 and 13.74%, respectively.

On the other hand, the ash content of male, brood, spent and jatka of fore part had 0.83, 0.86, 0.80, 0.78% middle part 0.88, 0.91, 0.84, 0.81% hind part 1.19, 1.34, 1.04, 0.97 % and viscera 1.22, 1.44, 1.16, 2.01% (Figure 8) respectively.

Shamim *et al*. [10] reported highest ash content found in caudal portion of fish body (1.35%) and lowest in ventral portion (1.05%). The value of ash in dorsal portion, ventral portion and caudal portion recorded as 1.31, 1.05 and 1.35% respectively. In a study Hossain *et al*. [19] with hilsa from Bay of Bengal and Arabian Gulf where ash content is lower (1.50±0.10) in hilsa from Arabian Gulf and ash content is higher (1.34 ±0.05) in hilsa from Bay of Bengal. Moniruzzaman *et al*. [9] study on nutritional value of spent and gravid hilsa where ash content is higher in gravid hilsa 2.45 ± 1.01% followed by spent hilsa 2.19 ± 1.0%.

In another experiment by Dewan *et al*. [20] determined different size group of hilsa where ash content was more or less same in different size groups. Ash content ranged from 0.81 to 0.87% with the highest value in adult and the lowest value in jatka. The ash content was highest in viscera 1.13%and lowest in dark muscle which was 0.91% which was nearer to the result of present findings. Similarly, Debnath *et al.* [21] observed nutritional value of hilsa and reported that the highest ash content (19.2 ± 0.42%) was recorded in the head region and lowest value (2.04± 0.29%) was found in the abdominal region of hilsa fish.

Changes in Moisture Content: The changes in moisture content in different portions on sex variable (male, brood, spent and juvenile) hilsa presented in Figure 9. In this study moisture in whole fish composition was found to be the main component ranging from 64.04 to 77.88% with the highest moisture content in jatka and the lowest in brood which recorded 67.33% in spent and 65.15% in male hilsa. The moisture content was decreased with increasing lipid content of different size group of hilsa. In this study the moisture content of male, brood, spent and jatka head was found 62.35, 58.34, 64.98 and 73.36% respectively.

On the other hand, the moisture content of male, brood, spent and jatka of fore part had 66.29, 64.30, 68.56, 78.09%, middle part 65.43, 62.43, 66.21, 76.92 % hind part 65.87, 63.11, 67.48, 77.81% and viscera 78.33, 77.30, 79.55, 82.67% (Figure 9) respectively.

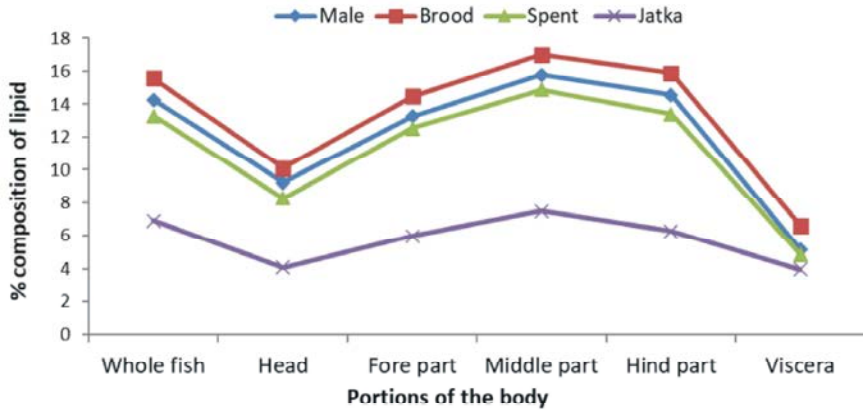

Fig. 7: Variations in lipid content at different portions of age and sex (male, brood, spent and juvenile) variable hilsa

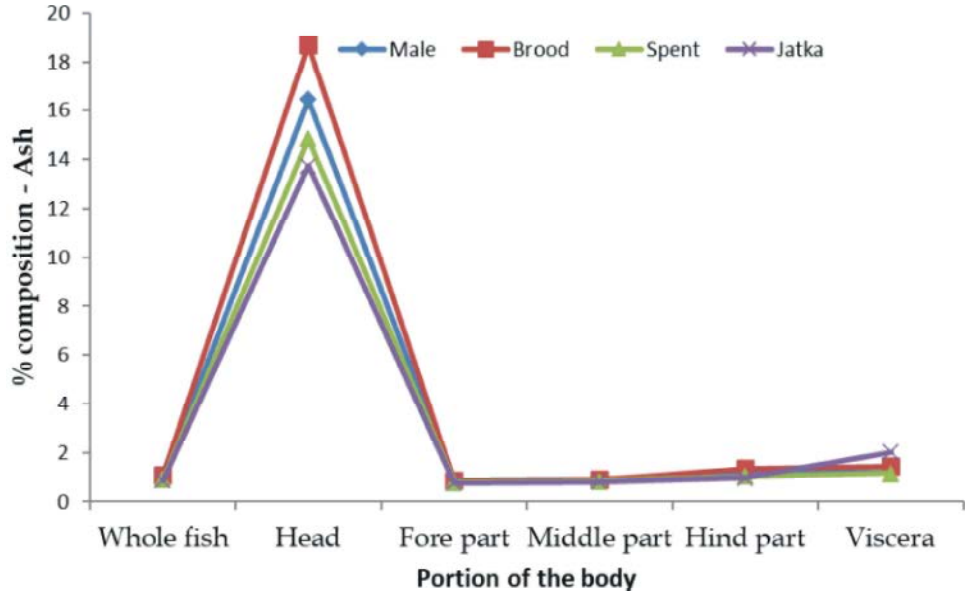

Fig. 8: Variations in ash content at different portions of age and sex variable male, brood female, spent and juvenile) hilsa

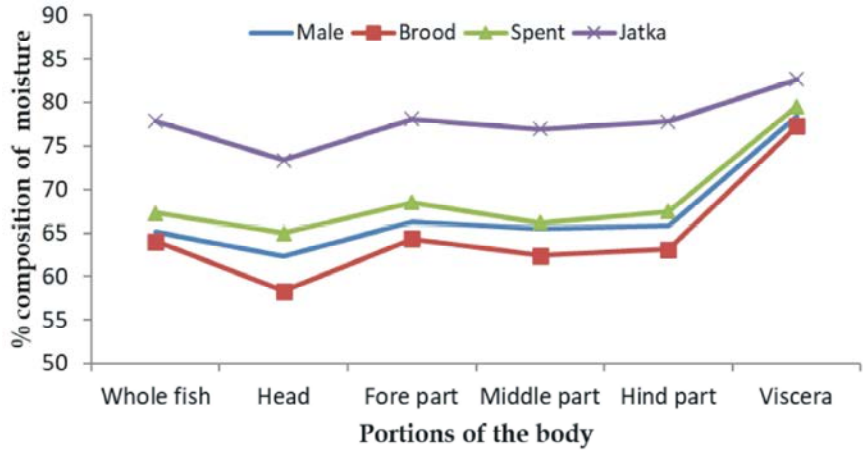

Fig. 9: Variations in moisture content at different portions of age and sex variable (male, brood, spent and juvenile) hilsa

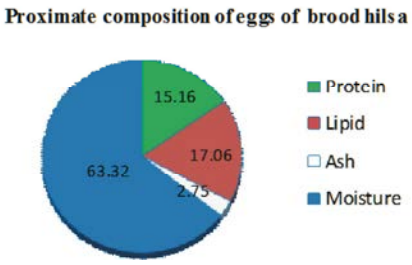

Fig. 10: Proximate composition of eggs of brood hilsa

Shamim *et al*. [10] reported moisture content of hilsa varied from 54.69 - 56.59%. The highest value was found in dorsal portion of the fish whereas the lowest value was in caudal portion of the fish. This finding has shown similarity with the findings of Sahu *et al.* [16]. According to him an adult hilsa weight 810.5±32.1g contain moisture in fore part, middle part and hind part 51.4±1.8%, 52.8±1.9% and 53.7±2.1%, respectively.

In another study Hossain *et al*. [19] reported proximate composition of hilsa from Bay of Bengal and Arabian Gulf where moisture content is lower (67.89±0.37) in hilsa from Arabian Gulf and moisture content is higher (60.37±0.25) in hilsa from Bay of Bengal. Moniruzzaman *et al*. [9] study on nutritional value of spent and gravid hilsa where moisture content was higher in spent hilsa 65.58 ± 0.87 followed by gravid hilsa 62.48 ± 0.54 %. In another experiment by Dewan *et al*. [20] recorded proximate composition of different size group of hilsa where he recorded moisture content ranged from 64.45 to 71.78% with the highest value in jatka and the lowest value in brood. The moisture content was found to be highest in viscera 79.33%and lowest in white muscle which was 66.05%. Similarly, Debnath *et al*. [20] observed nutritional value of hilsa and reported that the highest value of moisture (61.11 ± 0.42%) was in abdominal region whereas the lowest value (50.33±0.54%) was in head region of the fish. (57.92 ± 0.56%) moisture was recorded in the caudal portion of hilsa.

Hilsa Eggs Proximate Composition: Eggs of hilsa contain 63.32, 15.16, 17.06 and 2.75% moisture, protein, lipid and ash respectively. Based on lipid content, we can say that eggs could be used as decent source of lipid to nutrition.

This finding has shown similarity with the findings of Moniruzzaman *et al*. [9] who studied on nutritional profile of hilsa eggs from Bay of Bengal and from river where moisture content Bay of Bengal hilsa was 65.97% and riverine hilsa was 68.01%. Protein content was higher in the eggs of riverine hilsa 15.62%than 13.56% in Bay of Bengal hilsa. Although lowest fat observed in riverine hilsa eggs 14.77%, higher proportions of fat observed in Bay of Bengal hilsa eggs 16.83% representing their maturity for spawning. Ash of Bay of Bengal hilsa eggs were estimated as 2.67% riverine hilsa eggs 1.26%respectively. In another study Hossain *et al*. [19] observed proximate composition of hilsa eggs and reported that hilsa egg contains (22.27–23.08%) protein and moisture content of the egg was (50.04–60.38%). The high lipid content of the hilsa eggs (14.20–24.23%) found in this study and ash content of hilsa eggs was (1.97±0.11%).

CONCLUSION

The assessment of the proximate composition of the fish is not only important to know its nutritive value, but also for its better processing and preservation. Study of physical structure of fish is important in order to understand the nutrition profile and quality changes of fish. Carcass traits of hilsa are good indicator of edible and inedible yield that are easily and conveniently be determined. The final dressed yield (%) of hilsa fish (edible) depends upon the inedible portion which includes of head, scales, fins and visceral content of fish that makes a significant loss of nutrients of the fish. This type of loss in hilsa must be accounted as great loss.

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