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Proximate composition of three marine fishes of Chandipur, Bay of Bengal, India

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Abstract
Marine fishes have been recognized for high quality protein and essential fatty acids which play a vital role in human being for nutrition, disease prevention and quality of fish is assessed from biochemical composition only. Present study was carried out to analyze the biochemical composition % of three economically important fish species *Hilsa ilisha, Sillago sihama* and *Mugil cephalus* in Chandipur, Bay of Bengal on seasonal basis from March 2010 to February 2011 for a period of 2 years. Moisture content was highest in *S. sihama* (57.83 ±0.73) whereas protein and lipid % (21.89 ±0.42, 19.33 ±0.27) in *H. ilisha*. Ash content was independent of sex, size and season. No significant differences were observed (F =3.809, F =35.402, F =2955.39, P≤0.01) between *H. ilisha* and *M. cephalus* (Duncans Multiple Range Test). Result demonstrated that moisture content was high when lipid was low indicating inverse relationship with each other and lipid content was much more in *H. ilisha* than other two species.

Keywords: Biochemical composition, Chandipur, *Hilsa ilisha, Mugil cephalus, Sillago sihama,* Protein

1. Introduction
The biochemical composition of any edible organism is extremely important since the nutritive value is reflected its biochemical contents Nagabhushanam R *et al.* [1]. Now a day the demand for protein rich food is increasing, especially in developing countries, stimulating the exploration of unexploited resources. Marine fish have long been recognized as a valuable resource of high quality protein in human diet Kumaran R [2]. Consumption of marine fish provides an extensive source of protein with a high biological value, essential minerals and vitamins. Additionally the fish muscle contains little saturated fat and significant amount of vitamin C along with minerals such as calcium, potassium, zinc, iron, phosphorus and copper. Protein is essential substance of life and exists in the largest quantity of all nutrients as a component of the living being. Lipids are major sources of metabolic energy and essential for the formation of cell and tissue membrane Babu A *et al.* [3]. Fish proteins are rich in essential amino acids (EAA) and required for the maintenance, growth, reproduction and synthesis of vitamins. Further marine fish fats are good source of essential fatty acids that are not generally synthesized in the human body. Fatty acids in fish oil not only contain essential fatty acids but also a significant source of omega-3-fattyacids, which play a vital role in human nutrition, disease prevention and health promotion Frenoux JMR *et al.* [4].
Because of health consciousness, the modern day man is interested in taking sea food more in view of its nutritional superiority than all other sources of food accessible. Hence the present work has been designed to investigate the proximate composition of some highly consumable selected marine fishes of Chandipur coast, Bay of Bengal.

2. Materials and Methods
2.1 Sampling
Healthy fishes of three species, *H. ilisha, S. sihama* and *M. cephalus* were collected in a tenure of March 2010 to February 2011 from Chandipur landing centre (latitude $21^0 3^{'}$-$21^0 47^{'}$ N and longitude $86^0 02^{'}$-$87^0 20^{'}$E) of east coast of India, Bay of Bengal. They were measured individually for their standard length and weight and mean value were calculated. The size of the fishes ranged from 20-36 cm length and weight ranged from 270-800 gm. five fishes from each sex of each species were selected for this study and their habitat, average size is described in Table 1.

Table 1: Description of fish's source, Sex, Length, Weight and habitat at Chandipur coast.

Name of species	Author	Sex	Length in cm	Weight in gm	Habitat
Hilsh ilisha	Hamilton (1822)	Male	34.1 ±0.8	750.5 ±55.5	Demersal
		Female	34.6 ±2.3	800.5 ±77.6	Demersal
Mugil cephalus	Linneaus (1758)	Male	22.4 ±3.5	440.5 ±25.2	Pelagic
		Female	25.4 ±2.5	480.5 ±30.5	Pelagic
Sillago sihama	Forssakal (1775)	Male	20.4 ±3.2	270.3 ±20.2	Pelagic
		Female	22.2 ±2.5	320.4 ±18.2	Pelagic

2.2 Biochemical analysis

Body muscle samples (free from skin and scales) of different size and sex in each month were collected. The muscle tissue was homogenized in a hand homogenizer (BST-TH50, Bionics Scientific Tech. make), dried in the oven (Digital lab oven, 14"x14"x14", 42 L capacity, Lab line make) at 60 ^{0}C for 24 h and then transferred to a desiccators (Borosil 3082) prior to biochemical analysis. The moisture content was estimated by drying the pre weighed wet samples at 60 ^{0}C in hot oven until a constant weight was obtained. The difference in weight was calculated and expressed as % moisture content of the sample. All the samplings were done at room temperature. The dried samples were finely powered using mortar and pestle. Biochemical analysis of the samples was carried out by using standard methods. Protein was estimated by the method of Lowry *et al.* [5] and lipid was estimated by the method of Floch *et al.* [6]. All the values of biochemical components were expressed on percentage dry weight basis (% DWB).The ash content of a sample of the sample was determined by incineration in a muffle furnace (5x5x5, 960 ^{0}C, Sun lab make) at 550 ^{0}C till the residue became white Egan H *et al*. [7].

2.3 Data analysis

Both seasonal, sex wise and species wise variation in biochemical components were analyzed by one-way analysis of variance (ANOVA). The significance means were compared by Duncan's multiple range test (DMRT) at 5% probability level Duncan DB [8] by using SPSS software version 16.0.

3. Result

Seasonal and sex wise variation in biochemical components were tabulated for two years 2010 and 2011 respectively. The percentage composition of moisture was found to be more in *S. sihama* (57.35 ±0.25) during monsoon and 56.20 ±0.04, 54.53 ±0.19 in *M. cephalus* and *H. ilisha* respectively. Further the % composition of moisture was found to be higher in females than males (Fig.1a, 2a) for 2010 and 2011 respectively. Ash content was tabulated and the value ranged between 1.09 ±0.01 in female *H. ilisha* in 2010 to 1.48 ±0.05 in male Hilsa (2010) (Fig.1b). Seasonally highest ash percent (1.36 ±0.19) was observed in *M. cephalus* during winter 2010 and lowest value (1.08 ±0.03) in *S. sihama* during monsoon (2011) (Fig 2b).The ash content was found to be independent of size, species and sex as no distinct pattern was observed.

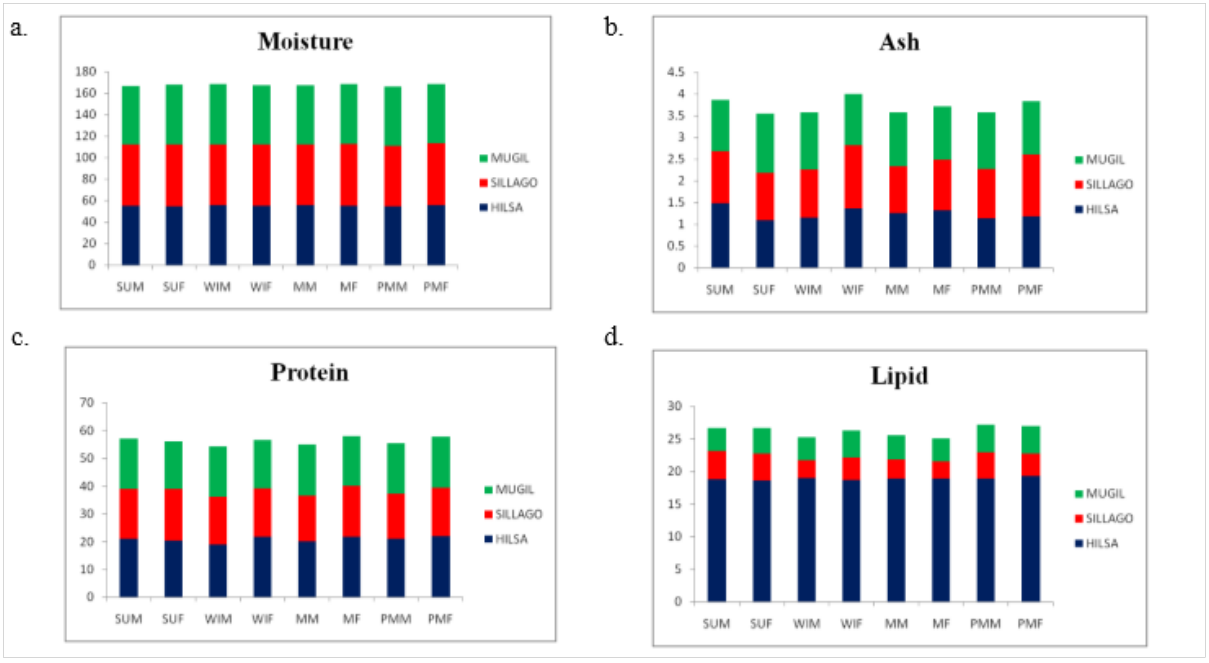

Fig 1: Seasonal variations of biochemical content in muscle tissue of *H. ilisha*, *S. sihama* and *M. cephalus* in 2010

SU= summer, WI= winter, M= monsoon, PM= post monsoon, M=male, F=female

The protein content of three species was estimated seasonally for 2011 and averages annually of 20.77 ±1.06 in *H. ilisha*, 17.47 ±0.89 in *S. sihama* and 18.00 ±0.5 in *M. cephalus* (Table 2). Seasonally in *H. ilisha* (females) the protein content was recorded to be more (21.62 ±0.15, 21.69 ±0.20) during monsoon and post monsoon (Fig 1c, 2c). The average protein content of *S. sihama* in 2010 was found to be 17.86 ±0.80 in summer, 17.18 ±0.02 in winter, 16.63 ±0.32 in monsoon and 16.27 ±0.01 in post monsoon (Fig. 1c). Similarly the protein content of *M. cephalus* was estimated to be 18.23 ±0.02 in summer, 18.16

±0.02 in winter 18.19 ±0.03 in monsoon and 19.06 ±0.01 in post monsoon (Fig 2c). Protein content of three species in four seasons of the year 2011 varied between 17.15 ±0.1 (female *S. sihama*) in summer to 19.35 ±0.3 (female *H. ilisha*) during post monsoon.

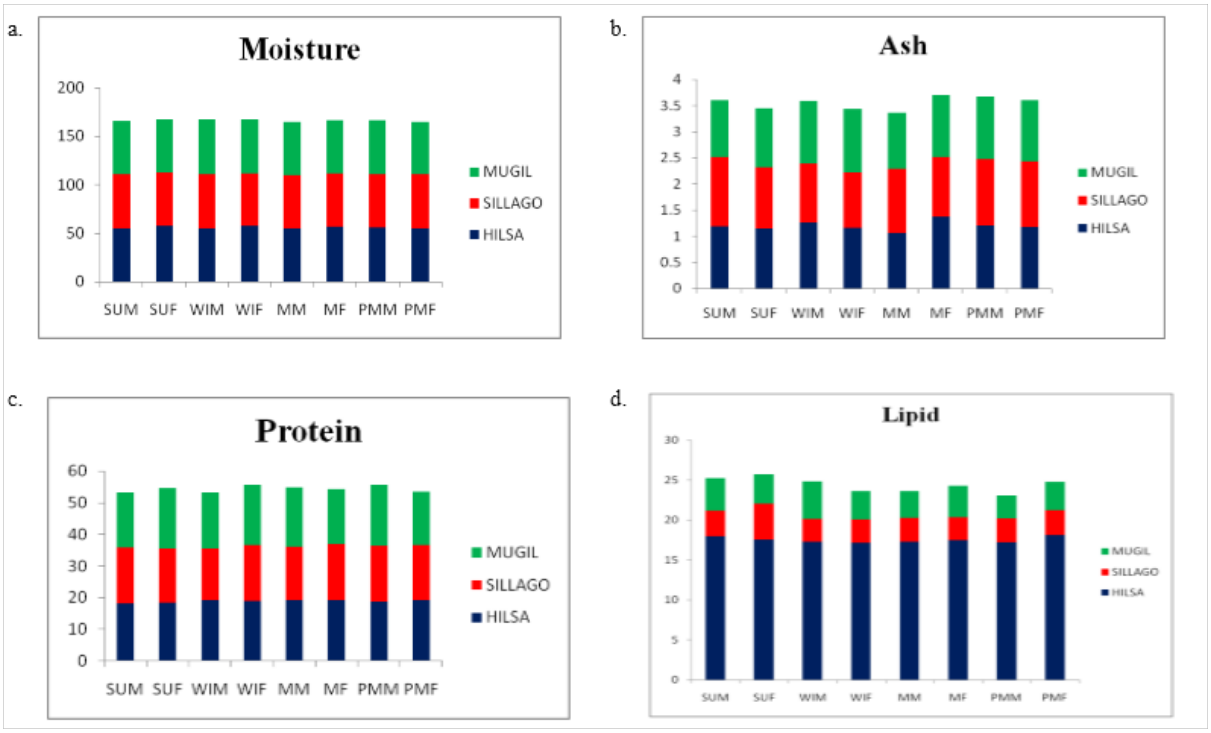

Fig 2: Seasonal variations of biochemical content in muscle tissue of *H. ilisha*, *S. sihama* and *M. cephalus* in 2011.

SU= summer, WI= winter, M= monsoon, PM= post monsoon, M=male, F=female

Lipid content varied between 2.80 ±0.02 (*S. sihama*) to 19.33 ±0.27 (*H. ilisha*) (Fig 1d) in 2010 and 2.88 ±0.13 (*S. sihama*) to 18.06 ±0.16 (*H. ilisha*) in 2011 (Fig. 2d). Annual average value of lipid content in 2010 was found to be 3.45 ±0.98 in *S. sihama*, 3.85 ±0.60 in *M. cephalus* and 18.88 ±0.42 in *H. ilisha* (Table 2) and 17.49 ±0.6 in *H ilisha*, 3.19 ± o.73 in *S. sihama* and 3.70 ±0.84 in *M. cephalus* in 2011. On sex wise comparison, the higher value of lipid (19.33 ±0.27) was observed in female *H. ilisha* than male (18.91 ±0.39). Seasonally the higher values of lipid in *H. ilisha* were associated with monsoon and post monsoon than summer and winter (Fig.1d, 2d). Average % of lipid content of three species in both the years showed lowest values in *S. sihama* and highest in *H. ilisha* (Table 2, 3).

Table 2: Proximate composition % of muscle tissue *H. ilisha, S. sihama, M. cephalus* from Chandipur, Bay of Bengal in 2010

	Species	Number	Mean	SD	SE
Moisture	*H. ilisha*	24	55.280[a]	0.764	0.156
	S. sihama	24	56.799[b]	0.765	0.156
	M. cephalus	24	55.478[a]	0.528	0.108
Ash	*H. ilisha*	24	1.236[a]	0.182	0.037
	S. sihama	24	1.205[a]	0.164	0.034
	M. cephalus	24	1.258[a]	0.149	0.031
Protein	*H. ilisha*	24	20.772[a]	1.069	0.218
	S. sihama	24	17.474[b]	0.896	0.183
	M. cephalus	24	18.008[c]	0.506	0.103
Lipid	*H. ilisha*	24	18.882[a]	0.426	0.087
	S. sihama	24	3.453[b]	0.986	0.201
	M. cephalus	24	3.857[b]	0.601	0.123

Values (mean±SD) in rows with different superscripts are significantly different (DMRT, $p \leq 0.05$)

No significant differences in moisture content of three species exhibited at 5% level (F = 3.809, P = 0.027). There was no difference of biochemical content between *H. ilisha* and *M. cephalus* (Table 3). Considering the moisture %, *S. sihama* is statistically different from other two species for the year 2010 and 2011. It was also revealed from the Table 2 and 3 from DMRT test that the mean ash percent of three species was found to be statistically non-significant which indicated that ash % had not any contribution in contrast to protein contents of the three species which were found to be highly significant (F =102.46,

P ≤ 0.01 for 2010 and F = 35.402, P ≤ 0.01 for 2011). Protein content was estimated to be more in *H. ilisha* followed by *M. cephalus* and *S. sihama* (Table 2, 3).

Table 3: Proximate composition % of muscle tissue *H. ilisha, S. sihama, M. cephalus* from Chandipur, Bay of Bengal in 2011

	Species	Number	Mean	SD	SE
Moisture	*H. ilisha*	24	55.820[a]	1.260	0.257
	S. sihama	24	55.305[ab]	0.822	0.168
	M. cephalus	24	55.079[b]	0.681	0.139
Ash	*H. ilisha*	24	1.194[a]	0.122	0.025
	S. sihama	24	1.200[a]	0.110	0.023
	M. cephalus	24	1.160[a]	0.109	0.022
Protein	*H. ilisha*	24	18.955[a]	0.495	0.101
	S. sihama	24	17.253[c]	0.637	0.130
	M. cephalus	24	18.186[b]	0.909	0.186
Lipid	*H. ilisha*	24	17.497[a]	0.602	0.123
	S. sihama	24	3.190[c]	0.730	0.149
	M. cephalus	24	3.709[b]	0.842	0.172

Values (mean±SD) in rows with different superscripts are significantly different (DMRT, p≤0.05)

After analyzing the data of lipid of three different species it was observed that the differences of the means was highly significant with each other for 2010(F =3674.51, P ≤0.01) and 2011 (F=1580.31, P ≤ 0.01). *Hilsa ilisha* showed much more lipid content than other two species.

4. Discussion

The proximate composition of muscle tissue of *H. ilisha*, *S. sihama*, *M. cephalus* was estimated and presented in figures which indicated that the major component of fish tissue was moisture. The fish moisture tends to decrease with increase of body lipid Majumdar R K *et al.* [9]. Protein is an indispensable nutrient required for the structure and function of all living organisms including fishes. Protein content of *H. ilisha* was higher (18.95 ±0.49) than other two species under study Hossain MA, *et al.* Pal M, *et al.* Shamsan EF, *et al.* [10, 11, 12]. Protein content of *S. sihama* was higher during monsoon and post monsoon Shamsan EF, *et al.* [12] which can be correlated with phases of maturity and spawning Das H P [14].The muscle protein content of *H. ilisha* in the present study is similar to muscle protein content of some popularly cultured marine fishes such as silver pomfret, seabream and grouper which ranged between 16.25 and 18.83% Hossain MA *et al.* [13].

High lipid content was reported in muscle of *H. ilisha* which is in agreement with different workers Nath AK, *et al.* Rao BM, *et al.* Mohanty BP *et al.* [15-17]. A rapid fall in lipid was observed during monsoon and post monsoon in *S. sihama* and attributed to less food intake. The pattern of changes in composition of lipid is governed by the rate of metabolism of fat, availability of food, environmental temperature and other factors Bumb S, Sikorski ZF, *et al.* [18, 19]. The higher lipid content of *H. ilisha* could be attributed to relative feeding habits Orban E *et al.* [20]. In addition to food, other factors such as species, size, reproductive status as well as the environmental characteristics can influence proximate composition Piggot GM *et al.* [21]. The distinctly higher content of lipids in *H. ilisha* than *S. sihama* and *M. cephalus* was observed as to accumulate energy reserves during their growth phase which are necessary for anadromous migration and spawning Rao BM, *et al.* Mohanty BP, *et al.* [16, 17]. The enormous input of water from rivers in the bay triggers movement of *H. ilisha* towards river mouth where the fish spends time to accumulate fat Hossain MA, *et al.* Das HP, Nath AK, *et al.* Rao BM, *et al.* Mohanty BP, *et al.* [13, 17]. Lipids and fatty acids play a significant role in membrane biochemistry and membrane mediated processes such as osmo-regulation, nutrient assimilation and transport in fishes but the nature and quantity of lipids in fish vary within species and habitat[2],[14].

5. Conclusion

The present study reflected seasonal changes in biochemical composition of the muscle tissue of *H. ilisha, S. sihama* and *M. cephalus* associated with feeding, growth, reproduction, storage and utilization of food reserves. Moisture content showed inverse relationship with lipid and lipid content showed variation within species, sex and season. However the protein content in three species was varied according to maturation and growth of the species.

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