Changes in the Biochemical Components of Hilsha Fish (*Tenualosa ilisha*) with Variation of its Size and Body Portions

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Introduction

As a source of food item, hilsha fish has an universal appeal to the consumers due to its delicacy, appealing flavour, high nutritional and therapeutic value and easy availability thoughout the year. Nearly one-fifth of the total animal protein intake of the people of the country is provided by hilsha alone[1]. It also provides with ω-3 fatty acids[2,3] which is regarded as the cholesterol reducing element of human serum[4].

It is, therefore, thought necessary to estimate the nutritional profile of the raw material (hilsha fish flesh) depending on various intrinsic factors. The variations due to the size and body portions are two important factors which influence the biochemical composition of the fish. The present paper deals with the changes of the macronutrient contents (protein and fat) and moisture and ash contents with the changes of size and various anatomical portions of hilsha fish.

Materials and Methods

The fish : Hilsha fish (*Tenualosa ilisha*) of different sizes like juvenile (2.4-28.3g), small (197-432g), medium (540-800g), and large (855-1775g) used for this study were collected throughout the year from different whole sale markets, major landing centres and catching areas.

Sampling : The proximate macro nutrient content of the edible portion of hilsha were determined from the pooled sample of six fish randomly picked up from each size group except the juveniles where a total of 1 kg fish was used.

Sample preparation : The fish, following physical measurements were washed, eviscerated and decapitated. Steaks (1.5 cm thick) were then removed from the nape centre

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and tail sections. These three steaks were combined together as representative of the whole muscle. Samples were also dissected out from the portions such as, the dorsal (D), ventral (V), tail (T), and the dark muscle (DKM), to analyze the composition of different anatomical portions. The samples from each portion were macerated into a homogeneous mass using an electric meat chopper.

Composition Analysis : Moisture, protein and ash contents were determined according to the official methods of AOAC[5]. Lipids were determined by the method of Bligh and Dyer[6].

Results

Effect of Size : The distribution of the macro nutrients like protein and fat, the moisture and ash contents in the edible muscle tissue of hilsha varied significantly ($p \leq 0.05$) according to the size/maturity of the fish (Fig. 1)

Moisture : The moisture content of hilsha muscle decreased with the increasing size of the fish. The smaller fishes contained higher moisture (77.73 ± 1.38 and 68 ± 1.07%) than the larger fish (62.55 ± 2.75%) (Fig. 1)

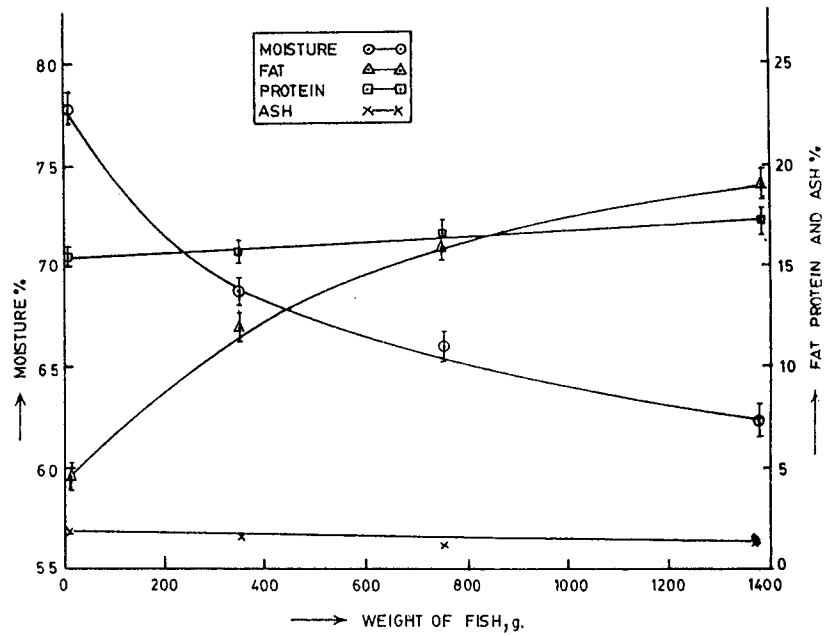


Figure 1. Effect of sizes on the biochemical composition of hilsha

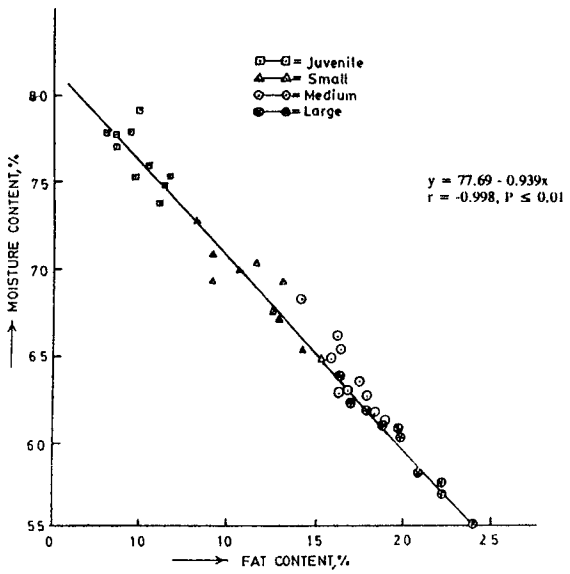
Fat : Fairly high level of fat which makes it a fatty species is found in hilsha. Contrary to the moisture the fat contents were higher in larger fish (18.91%) followed by medium (15.79%), small (11.80%) and juvenile (4.64%).

Protein : Nearly one-fifth of the weight of fish flesh constitutes the main structural body protein of hilsha. It varies from an average figures of 15.43 ± 1.27% in juvenile to 17.25 ± 0.77% in large fish, and the figure for small and medium were in between 15.71 ± 0.31% and 16.66 ± 0.37% respectively.

Ash : The proportion of ash contents, however, decreased slightly with the increase in size of the fish. While the small fish had slightly higher ash contents (1.80% in juvenile and 1.69% in small hilsha) due to smaller muscular spaces (having same number of bones) than in the medium (1.23%) and large (1.19%) fish.

The correlation co-efficient (r) between the size and the major nutrient contents like moisture (0.9165), protein (0.9499), fat (0.922) and ash (-0.9138) thus reveal inverse relationship with the moisture and ash and the direct relationship with the protein and fat contents (Fig. 1).

The variation is more pronounced between the lipid and water contents of hilsha producting typical fat-water line7, (Fig. 2; r = -0.998, p ≤ 0.01) which



Fugure 2. Fat – Water line of hilsha.

enables one to calculate roughly the lipid contents simply by plotting the moisture contents of the fish. The sum total of these two components remained at around the constant figure 80% in general.

Effect of body portions : The four principal components in various anatomical portions (dorsal, ventral, tail, dark muscles and whole fish region) of hilsha varied quite significantly ($P \leq 0.05$) due to its heterogeneous mixture of body structure.

Dorsal muscle : Dorsal muscles of hilsha comprises about one-half of the whole edible muscle (skin and boneless fillet) in the main bulk of the fillet. Dorsal muscle of large hilsha contained 63.91% moisture, 17.12% protein, 17.44% fat and 1.18% ash. The corresponding values of these components for medium, small and juvenile fish as shown in table-1 were again influenced by their size effect. For example moisture content decreased and the fat content increased with the increase in size of the fish. On the other hand the variation in protein and ash contents was minimum in this dorsal regions of all four sizes.

Ventral muscle : The posterior belly-flap or ventral region of hilsha constituted one-third of the total edible muscle. The four components range from 73.93-59.91% moisture, 15.92-17.12% protein, 7.26-22.44% lipid and 2.65-1.33% ash in juvenile, small medium and large hilsha.

Tail muscle : It constitutes almost one-fifth of the weight of hilsha and is the section that cut just anteriorly to the two propellent fins, which supplies power to the fins[8]. The distribution of the four basic constituents showed that this portion contained (in an average of different size) higher amounts of moisture (72.24 ± 3.95%), protein (17.40 ± 1.91%), ash (1.91 ± 0.36%) and lower amount of fat (7.68 ± 3.28%) as compared to the dorsal and ventral regions.

Dark muscle : The composition of dark muscle in hilsha was found to be different from that of white muscle in many respect (Table-1). The concentration of fat is strikingly high (22.75%) in contrast to that (11.54%) in the white (dorsal) muscle. The moisture (61.03 ± 3.4%), protein (14.70 ± 0.60%) and ash (0.83 ± 0.04%) contents in dark muscle were lower than those (69.9, 16.2 and 1.42% respectively) in white muscle.

Discussion

The size of hilsha has got an important influence on the major nutrients contents of the fish.

Tale 1. Macro-Nutrient Contents of Different Anatomical Portions of Hilsha in different Seasons (Figures are expressed as percent per 100g edible muscle average value ± SD)

Part	Fish	Moisture g%	Protein g%	Fat g%	Ash g%
Dorsal	JV	79.3 ± 2.64	15.05 ± 1.26	4.08 ± 0.76	1.45 ± 0.5
	SM	69.77 ± 0.6	15.95 ± 0.93	10.56 ± 1.45	1.74 ± 0.38
	MD	66.72 ± 1.52	16.84 ± 0.81	14.08 ± 1.89	1.43 ± 0.38
	L	63.91 ± 2.72	17.12 ± 0.6	17.44 ± 2.9	1.18 ± 0.03
*** MEAN ± SD**		**69.93 ± 5.79**	**16.24 ± 0.81**	**11.54 ± 4.95**	**1.45 ± 0.198**
Ventral	JV	73.93 ± 3.71	15.92 ± 0.69	7.26 ± 1.94	2.65 ± 0.45
	SM	65.23 ± 2.08	15.09 ± 0.62	15.53 ± 1.86	1.96 ± 0.45
	MD	62.56 ± 2.4	15.63 ± 0.07	19.27 ± 2.36	1.34 ± 0.08
	L	59.91 ± 3.2	17.12 ± 0.6	22.44 ± 2.6	1.33 ± 0.11
*** MEAN ± SD**		**65.41 ± 5.27**	**15.94 ± 0.75**	**16.13 ± 5.67**	**1.82 ± 0.54**
Tail	JV	78.51 ± 1.66	13.64 ± 3.3	2.45 ± 0.8	2.48 ± 0.35
	SM	72.5 ± 0.89	17.54 ± 1.25	7.99 ± 0.42	1.91 ± 0.48
	MD	69.88 ± 0.5	18.45 ± 0.8	8.8 ± 0.72	1.76 ± 0.36
	L	68.06 ± 1.08	18.97 ± 0.8	11.46 ± 0.55	1.50 ± 0.1
*** MEAN ± SD**		**72.24 ± 3.95**	**17.40 ± 2.34**	**7.68 ± 3.28**	**1.91 ± 0.36**
Dark Muscle	SM	65.3 ± 0.84	14.67 ± 1.25	19.01 ± 2.77	0.885 ± 0.16
	MD	60.81 ± 1.31	14.78 ± 1.31	22.69 ± 1.95	0.789 ±0.17
	L	56.99 ± 0.8	14.64 ± 0.93	26.56 ± 2.42	0.81 ± 0.27
*** MEAN ± SD**		**61.03 ± 3.4**	**14.70 ± 0.06**	**22.76 ± 3.08**	**0.83 ± 0.04**

*** Overall mean of the components**

JV – Juvenile fish weighing , 10.8g (2.4~28.3)
SM – Small fish " , 350g (197~432g)
MD – Medium fish " , 750g (540~800g)
L – Large fish " , 1385g (855~179)

Moisture, the major nutrient contents like other fresh water[9] and marine species[9] show inverse relationship whereas the fat content shows a direct relationship with the increasing size of the fish. The rate of increase in fat content and decrease in moisture content were higher in smaller fish. For example the rate was 1.84g per 100g fish weight in small fish upto 500g and 0.66g per 100g fish weight in larger fish over 500g.

However, in case of protein and ash the difference in the rate of changes between the above two groups were almost negligible. Similar type of variations among the above major

basic components were also found in both marine and fresh water fish of tropical and temperate regions[11,12,13, 8].

The changes in these nutrients among dorsal, ventral and tail muscle clearly shows that the concentration of fat was much higher in the ventral portion compared to dorsal and tail regions with the concomitant lower values of moisture content. Clupea harengues similarly showed the highest lipid level (27~31.6%) in the belly wall[13] as in hilsha of this regions. The variation in protein contents in the ventral part on the other hand was not so pronounced as found in dorsal part. Whereas the highest ash contents in tail section of hilsha might be due to inclusion of some small bones densely present in this section during maceration.

Similar trends of differences in the composition between the dark and white muscles were observed in all the sizes of hilsha. The extent of difference was higher in larger fish due to its comparatively higher proportion of dark tissue than in the smaller fishes. Fat in tuna (*Katsuwonus pelamis*) was more concentrated in dakmeat while, moisture and protein contents were higher in white muscle[14]. In the previous findings it has been established that protein and moisture are lower in the dark fatty tissues, replacing protein as well as water by fat as has been found in hilsha in present study[15, 16]. Similar variations in body composition between dark and white muscle of large *Hilsha ilisha* were found by other workers[17].

It can be concluded that the distribution of the major components and the quantity of fat varies according to the differences in anatomical regions of hilsha, and the muscle from various portion of the same fish may show appreciable variations in their nutrient contents. A knowledge of the heterogeneous distribution of the nutrients in different parts of the body of hilsha may help in selecting a suitable portion of the fish for inclusion in the diet of person of particular age group and physical condition.

Summary

The macro nutrients, protein, fat moisture and ash contents in different size of hilsha vary signifcantly ($p \leq 0.05$) with the increase in size and maturity of fish. Moisture and fat contents correlated inversely in almost all the cases. The moisture level increased from 62.55 ± 2.75% in large to 77.73 ± 1.38% in juvenile fish with the concomitant decrease in fat content from 18.91 ±

2.15% in large to 4.64 ± 0.92% in juvenile. The protein content remains within 15.43 ± 1.27% in juvenile to 17.25 ± 0.77 in large hilsha and the figures for the small (15.71 ± 0.3%) and medium (16.66 ± 0.37%) remained in between. No prominent changes were observed in the ash contents which remained around one percent of the total weight in all the four sizes of hilsha. Among the different anatomical portions studied the fat content was found maximum in the dark muscle (26.56 ± 2.42%) followed by ventral (22.44 ± 2.6%), dorsal (17.44 ± 2.9%) and the tail (11.46 ± 0.55%) portion in large hilsha. The protein content was the highest in tail (17.40 ± 2.34%) and the lowest (14.70 ± 0.06%) in the dark muscle. The amount of ash remains around 1-2% throughout the body portions studied.

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