Studies on Certain Aspects of Nutritive Value of Indian Halibut, *Psettodes erumei* with Special Reference to its Body Asymmetry

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Psettodes erumei contains 18.79% of protein. Its fat content is only 0.55%. The mineral content is quite comparable to other marine fishes with the exception of low calcium content. Outstanding among all the modifications is the asymmetrical distribution of fat. Fat content on the blind side is about 70% higher than that of ocular side. Fat, phosphorus and potassium exhibit regional variations in their distribution. The fish has 56.24% edible portion and that of ocular side is about 23% higher than that of blind side.

A vast wealth of information on the food values of different groups of fishes are available. In spite of the fact that a lot of information are available on the proximate composition and mineral content of a good number of fish species of India, it is noticed that some of them are highly contradictory. The iron content of *Hilsa ilisha* was reported to be 3.37 mg/100g of raw fish by Setna *et al.* (1944) but Anon (1962) reported it to be 213 mg/100g. Saha & Guha (1930) and Natarajan & Sreenivasan (1961) reported the iron content of *C. mrigala* to be 109 mg/100g and 7,200 mg/100g respectively. A review of the relevant literature reveals that scarcely any attempt has been made for any systematic investigation of nutritive value of the flatfishes of India in general, and *Psettodes erumei* in particular. In view of these facts, attempt has been made to investigate the proximate composition and mineral content of the edible portion of *Psettodes erumei*.

Flatfishes are unique among the vertebrates due to the bilaterally asymmetrical nature of their body. The present investigation is an attempt to study the impact of such asymmetry on the proximate composition and mineral content of the body musculature.

Materials and Methods

Freshly caught female *Psettodes erumei* of body length 35–45 cm were washed thoroughly, dipped in chloromycetin solution (250 mg/litre) and brought to laboratory in ice. After filtering samples of body muscles were taken alongwith the overlying skin from different regions of the body. The body of the fishes was demarkated into three regions as follows:

Region I Behind head upto 32nd dorsal fin ray
II 33rd to 45th dorsal fin ray
III 46th dorsal fin ray to end of caudal peduncle

The letters 'O' and 'B' have been used in the text to designate ocular and blind sides of the body respectively. Samples were analysed for moisture, protein, fat and ash contents according to the methods of AOAC (1960). Phosphorus and iron have been estimated following the methods of Fiske & Subba Row (1925) and Wong (1928) respectively. Sodium, potassium and calcium contents have been analysed by flame photometry. Paired t-test and one way classification model for Analysis of Variance test (ANOVA) have been used following Gupta (1980) and Misra & Misra (1983).

Results and Discussion

P. erumei has proximate composition and mineral content as follows: moisture 78.67%, total protein 18.79%, fat 0.55%, ash 1.07%, potassium 0.34%, sodium 0.14%, phosphorus 0.17%, calcium 0.04% and

Table 1. *Proximate composition and mineral content of edible portion of P. erumei*

	Average %	SD	SE
Moisture	78.67	0.59	0.1
Protein	18.79	1.24	0.22
Fat	0.55	0.24	0.04
Ash	1.07	0.11	0.02
Potassium	0.34	0.04	0.007
Sodium	0.14	0.01	0.001
Phosphorus	0.17	0.01	0.002
Calcium	0.04	0.005	0.0009
Iron	0.008	0.0009	0.0001

iron 0.008% (Table 1). Brandes & Dietrich (1953) recorded a gradual increase in protein content from behind the head towards tail. However, in the presently studied fish, no statistically significant difference in the protein content of different regions has been noticed (Tables 3 & 4). According to Brandes & Dietrich (1958) the fat content in the lean and semifatty fishes generally increases from head section towards the tail. *P. erumei* seems to have followed this rule only on its blind side; the fat content of region III is significantly higher than those of regions I and II (Table 4). Outstanding among all these peculiarities is the nature of distribution of body fat with

Table 2. *Comparison of proximate composition and mineral content of ocular and blind sides of P. erumei*

	Region I		Region II		Region III		Total	
	Ocular/ Blind side	Cal. 't'	Ocular/ Blind side	Cal. 't'	Ocular/ Blind side	Cal. 't'	Ocular/ Blind side	Cal. 't'
Moisture %	78.76	2.62	78.38	1.54	78.51	0.98	78.55	1.64
	79.04		78.67		78.67		78.79	
Protein %	18.80	1.13	19.02	0.34	19.04	0.35	18.95	0.62
	18.28		18.81		18.73		18 61	
Fat %	0.342	3.54*	0.434	3.02*	0.454	5.02**	0.409	7.180**
	0.519		0.616		0.956		0.697	
Ash %	1.08	1.04	1.13	0.15	1.10	1.83	1.10	2.48
	1.02		1.11		0.968		1.04	
Potassium %	0.336	0.150	0.351	0.710	0.332	0.970	0.340	0.340
	0.333		0.387		0.322		0.346	
Sodium %	0.148	0.280	0.146	0.230	0.156	0.180	0.150	0.280
	0.150		1.142		0.154		0.148	
Phosphorus %	0.171	0.880	0.186	2.330	0.182	4.48*	0.179	1.440
	0.177		0.173		0.167		0.172	
Calcium %	0 047	0.600	0.047	0.800	0.048	1.120	0.047	1.290
	0.046		0.045		0.046		0.046	
Iron %	0.0084	0.5000	0.0086	0.6800	0.0083	0.0300	0.0084	0.5400
	0.0084		0.0064		0.0083		0.0076	

* $P<0.05$ (significant at 5%); ** $P < 0.01$ (significant at 1%)

Table 3. *ANOVA Table for determination of regional variation of proximate composition and minerals of ocular side of P. erumei*

	Source of variation	Sum of squares	Degree of freedom	Mean square	F value
Moisture	Between the region	0.373	2	0.186	0.45
	Within the region	4.897	12	0.408	
	Total		14		
Protein	Between the region	0.173	2	0.086	0.03
	Within the region	34.553	12	2.879	
	Total		14		
Fat	Between the region	0.036	2	0 018	0.9
	Within the region	0.242	12	0.020	
	Total		14		
Ash	Between the region	0 007	2	0.003	0.375
	Within the region	0.102	12	0.008	
	Total		14		
Potassium	Between the region	0.001	2	0.0005	0.25
	Within the region	0.024	12	0.0020	
	Total		14		
Sodium	Between the region	0.00025	2	0.00012	1.33
	Within the region	0.00112	12	0.00009	
	Total		14		
Phosphorus	Between the region	0.00065	2	0.00032	4.0*
	Within the region	0.00105	12	0.00008	
	Total		14		
Calcium	Between the region	0.00006	2	0 00003	0.66
	Within the region	0.00054	12	0.000045	
	Total		14		
Iron	Between the region	0.000002	2	0 0000010	1.66
	Within the region	0.000008	12	0.0000005	
	Total		14		

* $P < 0.05$ (significant at 5%); LS D of phosphorus= 0 012;
Difference between mean values of phosphorus $I_o - II_o = 0.171 - 0.186 = 0.015+$; $I_o - III_o = 0.171 - 0.182 = 0.011$; $II_o - III_o = 0.186 - 0.182 = 0.004$; + Difference is significant

Table 4. *ANOVA Table for determination of regional variation of proximate composition and minerals of blind side of P. erumei*

	Source of variation	Sum of squares	Degree of freedom	Mean square	F value
Moisture	Between the region	0.462	2	0.231	0.66
	Within the region	4.20	12	0.35	
	Total		14		
Protein	Between the region	0.849	2	0.424	0.617
	Within the region	8.261	12	0.688	
	Total		14		
Fat	Between the region	0.527	2	0.263	9.41**
	Within the region	0.341	12	0.028	
	Total		14		
Ash	Between the region	0.082	2	0.041	2.73
	Within the region	0.180	12	0.015	
	Total		14		
Potassium	Between the region	0.020	2	0.010	10.0**
	Within the region	0.013	12	0.001	
	Total		14		
Sodium	Between the region	0.00057	2	0.00028	1.12
	Within the region	0.00300	12	0.00025	
	Total		14		
Phosphorus	Between the region	0.0005	2	0.00020	1.66
	Within the region	0.0015	12	0.00012	
	Total		14		
Calcium	Between the region	0.00005	2	0.000025	1.99
	Within the region	0.00026	12	0.000021	
	Total		14		
Iron	Between the region	0.000006	2	0.0000030	1.30
	Within the region	0.000028	12	0.0000023	
	Total		14		

LSD of fat = 0.2307
Difference between mean values of fat
IB – IIB = 0.519 – 0 616 = 0.097
IB – IIIB = 0.519 – 0.956 = 0.437+
IIB – IIIB = 0.616 – 0.956=0.34+
+ Difference is significant

LSD of potassium = 0.0436
Difference between mean values
IB – IIB = 0.333 – 0.387=0.054+
IB – IIIB = 0.333 – 0.322 = 0.011
IIB – IIIB=0.387 – 0.322=0.065+
**significant at 1%

reference to bilateral asymmetry. The fat content of blind side is about 70% higher than that of the ocular side, and such asymmetrical distribution has been recorded in all the three regions of the body (Table 2). The sodium and potassium content in *P. erumei* is very similar to those of other Indian sea fishes as reported (Anon, 1962). Opinion on variation in distribution of sodium and potassium in the body of fishes is of divergent nature. Kruchakova (1952) found increase in sodium and potassium at the tail end. However, Thurston (1958), Thurston & Groninger (1959) observed that the sodium content is higher, whereas, potassium is lower at the head end as compared to the middle section in case of *Oncorhynchus gorbuscha*. Contrary to his earlier observation, Thurston (1962) again noticed the increase of both sodium and potassium at the tail end in case of Siscowet trout. The present investigations does not show any significant regional variation in distribution of sodium and potassium with the exception of middle region on the blind side, which contains prominantly higher amount of potassium (Tables 3 & 4). Distribution of phosphorus in the body exhibits a distinct bilateral asymmetry. The ocular side of region III possesses higher phosphorus content than its counter part of blind side (Table 2). The reason behind it, might be, due to the presence of body pigment only on the ocular side. Oser (1971) reported the iron content in halibut and flounder to 0.0008 and 0.001% respectively. However, the present study reports a slight higher iron content, ie. 0.008%. The bilateral asymmetry of the body does not seem to have any significant impact on the distribution of moisture, protein, sodium, potassium, calcium and iron. Sinnhuber *et al.* (1956) also did not notice any asymmetrical distribution of moisture and protein between the left and right fillets of doversole.

Setna *et al.* (1944), and Natarajan & Sreenivasan (1961) noticed the percentage of edible portion of a large number of fish and found it to vary from 30 to 50%. However, the percentage of edible portion of *P. erumei* has been found to be 56.24% (Table 5).

Bilateral asymmetry of the body has remarkably affected the distribution of body flesh. The percentage of edible portion of all the three regions of ocular side is significantly higher than of counter parts of blind side as the body contour of the ocular side is more convex.

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Table 5. *Percentage of edible portion of P. erumei with reference to bilateral asymmetry and regional variation*

Region I		Region II		Region III		Total	
% of edibility of Ocular/ Blind side (Total)	Cal 't'	% of edibility of Ocular/ Blind side (Total)	Cal 't'	% of edibility of Ocular/ Blind side (Total)	Cal 't'	% of edibility of Ocular/ Blind side (Total)	Cal 't'
9.78 (16.91)	***	12.91 (21.47)	***	9.10 (14.23)	***	31.80 (56.24)	**
7.13	14.65	8.56	12.61	5.33	22.56	24.44	6.4

** $P < 0.01$ (significant at 1%); *** $P < 0.001$ (significant at 0.1%)

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