NOTES

STUDIES ON THE ASYMMETRICAL BODY OF AN INDIAN SOLE *SYNAPTURA COMMERSONIANA* — A BIOCHEMICAL ANALYSIS

ABSTRACT

The body muscles of *Synaptura commersoniana* contain 81.31% moisture, 16.32% protein, 0.51% fat and 0.87% ash. The distribution of moisture, protein, fat, ash, sodium and potassium in the body muscle neither exhibit bilateral asymmetry nor any regional variation. One of the outstanding modifications is the asymmetrical distribution of phosphorus in the body. Its content on the ocular side of the body is higher than that of blind side. Calcium content of ocular side of region-I is also higher than its counter part of blind side. Body asymmetry has also significantly distorted the distribution of body flesh. Ocular side of the body contains more body flesh than that of blind side.

Introduction

FISHES belonging to order Pleuronectiformes are unique due to the bilaterally asymmetrical nature of their body, a feature contradictory to the fundamental principle of vertebrates. Such an interesting phenomenon has drawn the attention of a large number of investigators like Traquair (1865), Kyle (1923), Dobben (1937), Block (1957), Ochiai (1966) and Menon (1977) to study the various anatomical aspects of body asymmetry. Yazdani (1969) observed the adaptations of jaws of different groups of flatfishes with special reference to asymmetry. Datta and Das (1984 a, b, 1985) investigated the impact of body asymmetry on the osteological architecture, myological make-up and reproductive system of certain tongue soles belonging to *Cynoglossus* sp. and *Paraplagusia* sp. Das and Datta (1987 a, b) also observed the modifications of the neurocranium and cranial ligaments with reference to body asymmetry in *Cynoglossus* sp. The present communication is an attempt to determine how far the body asymmetry has distorted the distribution of body flesh, their proximate composition and mineral content in *Synaptura commersoniana* (Fig. 1). Such information will be extremely useful to understand the biochemical basis of adaptations of this peculiar fish. Heterogeneity of body muscles in fishes is well known due to the pioneering contributions of Nagayama (1961), Fraser *et al.* (1966) and Black *et al.* (1962). However, in the fish under investigation, the problem becomes more complicated due to the asymmetrical nature of its body. In view of this fact, regional variation of the proximate composition and mineral content of body tissue have also been observed with special reference to asymmetry.

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Material and methods

Synaptura commersoniana were procured from freshly caught marine catches and were brought to laboratory after dipping them in chloromycetin solution (250 mg/l). After filleting, muscle samples were taken along with the overlying skin from three different regions of the body. The body of the fishes were demarcated into three regions as follows:

Region — I : Behind head upto 22nd dorsal fin ray.
II : 23rd to 34th dorsal fin ray.
III : 35th to end of caudal peduncle.

Muscle samples were analysed for their proximate composition following AOAC (1960). The sodium, potassium and calcium have been analysed by Flame photometry. Iron and phosphorus have been estimated following the method of Wong, Fiske and Subba Row respectively (Raghuramulu *et al.*, 1983). For comparison of data of ocular and blind sides, paired 't' test has been used (Misra and Misra, 1983). To determine regional variations, one way classification model of analysis of variance (ANOVA) has been employed following Gupta (1980). In order to avoid variation due to influence of sex and size, only female fishes of body length 20 - 30 cm were taken.

TABLE 1. *Proximate composition and mineral content of skeletal muscles of* S. commersoniana

Proximate and minerals	Ave %	SD	SE
Moisture	81.31	1.48	0.27
Protein	16.32	0.83	0.15
Fat	0.51	0.61	0.11
Ash	0.87	0.12	0.02
Potassium	0.29	0.068	0.012
Sodium	0.14	0.014	0.002
Phosphorus	0.109	0.016	0.002
Calcium	0.039	0.004	0.0008
Iron	0.007	0.0015	0.0002

Results

Table 1 shows the average proximate composition and mineral content of skeletal muscle along with their standard deviation and standard error. Comparison of data of ocular and blind sides with the help of 't' test has been provided in Table 2. Table 3 and 4 show 'F' values of analysis of variance test for determination of regional variation of proximate and minerals of ocular and blind sides. But none of the 'F' value is significant. Results of 't' test for comparison of body flesh quantity of ocular and blind sides have been given in Table 5.

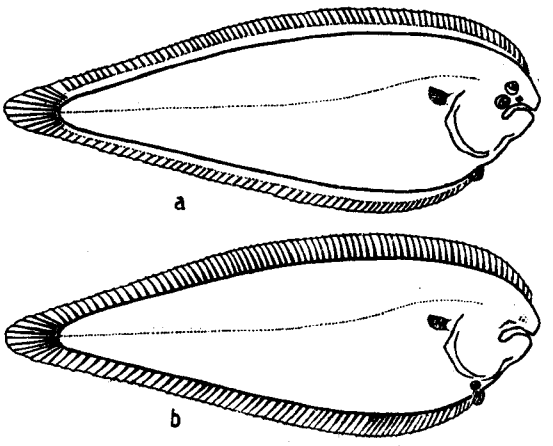

Fig. 1. *S. Commersoniana* (B 1.29 cm) : (a) ocular side and (b) blind side.

Discussion

S. commersoniana contains 81% of moisture and the same is distributed equally in all the three regions of the body as well as on both ocular and blind sides. The protein content is 16.32%, which is quite comparable with other commonly available marine fishes (Anon., 1962). But its distribution in the body muscle is not affected by the asymmetry. Brandes and Dietrich (1953 a) observed the distribution of protein in six regions of *Clupea*

TABLE 2. *Comparison of % of proximate composition and mineral content of ocular and blind sides of* S. commersoniana

	Region — I		Region — II		Region — III		Total	
	Ocular side / Blind	Cal 't'	Ocular side / Blind	Cal 't'	Ocular side / Blind	Cal 't'	Ocular side / Blind	Cal 't'
Moisture	81.36 / 81.29	0.49	81.21 / 81.25	0.16	81.52 / 81.24	1.34	81.36 / 81.26	0.68
Protein	16.37 / 16.17	0.55	16.11 / 16.53	1.10	16.34 / 16.53	0.43	16.27 / 16.40	0.55
Fat	0.485 / 0.412	1.01	0.336 / 0.253	0.800	0.860 / 0.750	0.610	0.560 / 0.470	1.130
Ash	0.91 / 0.85	1.58	0.88 / 0.90	0.56	0.85 / 0.86	0.17	0.88 / 0.87	0.50
Potassium	0.314 / 0.290	2.440	0.290 / 0.300	0.270	0.250 / 0.320	2.260	0.280 / 0.300	0.880
Sodium	0.13 / 0.14	2.58	0.153 / 0.140	1.89	0.14 / 0.13	0.97	0.14 / 0.14	0.43
Phosphorus	0.119 / 0.109	3.42*	0.115 / 0.092	1.54	0.112 / 0.106	1.23	0.115 / 0.102	3.51*
Calcium	0.040 / 0.039	3.22*	0.04 / 0.03	2.7	0.039 / 0.037	1.0	0.040 / 0.037	2.75
Iron	0.0079 / 0.0071	0.66	0.0078 / 0.0066	1.84	0.0070 / 0.0076	0.78	0.0075 / 0.0069	0.73

* Significant at P = < 0.05

harengus musculature and recorded a gradual increase in protein content from behind the head towards the tail. However, in the presently studied fish, no statistically significant difference in the protein content of different regions has been noticed. *S. commersoniana* contains only 0.51% of fat and thus, it can be considered as a lean fish according to the classification of Srivastava (1985). The presence of high moisture and low fat content confirms the earlier observation of Brandes and Dietrich (1953 b) and Mikicinska (1954) that there exists a negative correlation between moisture and fat content of a tissue. According to Brandes and Dietrich (1958), the fat content in the lean fishes, generally increases from head section towards the tail. But this rule does not hold good in the presently studied fish, as there is no regional variation in the distribution of fat has been noticed. Bilateral asymmetry of the body also does not have any significant impact on the fat distribution. Sinnhuber *et al.* (1956) also did not find any variation in the moisture, protein or fat content between the left and right fillets of dover sole. Ash, sodium, potassium and iron content of *S. commersoniana* are of usual teleostean pattern and are distributed evenly on both the sides of the body. Opinions

TABLE 3. *'ANOVA' for determination of regional variation of proximate and munerals of ocular side of* S. commersoniana

	Source of variation	Sum of squares	Degree of freedom	Mean square	F value
Moisture	Between the region	0.231	2	0.115	0.049
	Within the region	28.19	12	2.34	
	Total		14		
Protein	Between the region	0.208	2	0.104	0.10
	Within the region	11.702	12	0.975	
	Total		14		
Fat	Between the region	0.728	2	0.364	1.05
	Within the region	4.160	12	0.346	
	Total		14		
Ash	Between the region	0.011	2	0.0055	0.32
	Within the region	0.209	12	0.0170	
	Total		14		
Potassium	Between the region	0.013	2	0.00650	2.11
	Within the region	0.037	12	0.00308	
	Total		14		
Sodium	Between the region	0.00087	2	0.00043	2.68
	Within the region	0.00200	12	0.00016	
	Total		14		
Phosphorus	Between the region	0.00058	2	0.00029	1.526
	Within the region	0.00228	12	0.00019	
	Total		14		
Calcium	Between the region	0.00006	2	0.000030	1.07
	Within the region	0.00034	12	0.000028	
	Total		14		
Iron	Between the region	0.0000024	2	0.0000012	0.279
	Within the region	0.0000510	12	0.0000043	
	Total		14		

* Significant at P = < 0.05

are quite divergent regarding regional variation in the distribution of sodium and potassium in different groups of fishes (Kruchakova, 1952; Thurston, 1958; Thurston and Groninger, 1959). In the present fish, no such regional variation in the distribution of ash, sodium, potassium and iron has been recorded. One of the most remarkable modifications, which has been recorded for the first time, is the peculiar nature of distribution of phosphorus and calcium in the body. The phosphorus content of the ocular side is significantly higher than that of the blind side. This might be due to the presence of pigments only on the ocular side of the body. The calcium content of the ocular side of region I is also higher than its counter part of blind side. Bilateral asymmetry of the body also has a remarkable impact on the nature of distribution of body flesh. The ocular side of the body has been recorded to contain more amount of flesh in all the three regions of the body in comparison to blind side. This is due to the more convex nature of the body on the ocular side than that of blind side. The amount of flesh is also gradually reduced from region I to III as the body is tapering posteriorly.

TABLE 4. *'ANOVA' for determination of regional variation of proximate and minerals of blind side of* S. commersoniana

	Source of variation	Sum of squares	Degree of freedom	Mean square	F value
Moisture	Between the region	0.036	2	0.118	0.006
	Within the region	35.58	12	0.96	
	Total		14		
Protein	Between the region	0.445	2	0.222	0.279
	Within the region	9.525	12	0.793	
	Total		14		
Fat	Between the region	0.668	2	0.334	0.73
	Within the region	5.463	12	0.455	
	Total		14		
Ash	Between the region	0.0075	2	0.0037	0.208
	Within the region	0.223	12	0.0180	
	Total		14		
Potassium	Between the region	0.0071	2	0.0035	0.05
	Within the region	0.0849	12	0.0070	
	Total		14		
Sodium	Between the region	0.00049	2	0.00024	1.7
	Within the region	0.00170	12	0.00014	
	Total		14		
Phosphorus	Between the region	0.00087	2	0:000435	1.812
	Within the region	0.00292	12	0.000240	
	Total		14		
Calcium	Between the region	0.000012	2	0.000006	0.315
	Within the region	0.000220	12	0.000019	
	Total		14		
Iron	Between the region	0.00000235	2	0.00000115	0.958
	Within the region	0.00001510	12	0.00000125	
	Total		14		

* Significant at P = < 0.05

TABLE 5. *Nature of distribution of body muscles in* S. commersoniana. *Percentage of muscles in relation to total body weight at three regions and in total*

Region I			Region II			Region III			Total		
Ocular / Blind side	Total	Cal 't'	Ocular / Blind side	Total	Cal 't'	Ocular / Blind side	Total	Cal 't'	Ocular / Blind side	Total	Cal 't'
9.33 / 6.84	(16.17)	*** 9.62	9.65 / 6.50	(16.15)	** 6.96	6.77 / 4.61	(11.38)	*** 10.96	25.76 / 17.07	(42.83)	* 7.24

* P = < 0.05 (Significant at 5%), ** P = < 0.01 (Significant at 1%), *** P = < 0.001 (Significant at 1%)

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SOME HYDROGRAPHICAL FEATURES OF A BRINE SHRIMP ECOSYSTEM AT TUTICORIN

ABSTRACT

The fluctuations in salinity, dissolved oxygen and pH in a natural ecosystem of the brine shrimp *Artemia salina* at Tuticorin salt pan area were studied for a period of seventeen months from November 1984 to March 1986 and the cyst production was observed to take place when the level of salinity and dissolved oxygen ranged between 104 and 138 ppt and 0.5 and 2.1 ml/l respectively.

EVERSINCE it was first reported by Seale (1933) that the freshly hatched nauplii of the brine shrimp *Artemia salina* are the most suitable food for the fish fry, there has been a growing demand for the cysts of the brine shrimp. As the production of the cysts under controlled