

Original Research Article

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## Distribution of Body Energy in *Etroplus suratensis* (Bloch)

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### ABSTRACT

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The present study was carried out to find out the distribution energy pattern in the body parts of *Etroplus suratensis* (bloch). The study indicated that the mean energy density of the edible portion of immature fish was 17.47 kJ/g dry weight compared 20.20 kJ/g and 19.65 kJ/g of adult female and male respectively. Similarly the energy density of inedible portion of immature fish was 15.65 kJ/g while that of adult female and male were 17.49 kJ/g and 16.62 kJ/g dry weight respectively.

### Introduction

The pearl spot, *Etroplus suratensis*, is an estuarine fish of commercial importance. It possesses certain requisite qualities essential for aquaculture such as good body weight, growth rate, high adaptability for food, tasty flesh and good market price (Joseph, 1980; Jayaprakash and Phil, 1980; Rattan, 1994). *Etroplus suratensis* a widely cultured species in the Indo-pacific region and is known to breed in confined waters (Hora and Pillay, 1962).

Being euryhaline, the species could easily be acclimatized to fresh waters indicating its suitability in pond aquaculture. *E. suratensis* is also maintained as all aquarium fish because of its attractive colouration (Rattan, 1994). However, the successful culture of any endemic species, Information on feeding habits, digestive physiology, reproductive biology, water quality parameters, proximate analysis of body parts etc. are the prerequisites. Hence the present research was carried out to find out energy distribution in the fish

## Materials and Methods

### Fish sampling site

The present investigation was carried out in the estuarine area formed by the confluence of Mulki (Shambhavi) and Pavanje rivers and both open into the Arabian sea at a point about 29 KM north of Mangalore in south India (13° 05' N; 74° 47' E). The area has been referred to as Mulki estuary, since the Mulki river is the major water source, while Pavanjeriveris only a tributary. The estuary is flooded with fresh water from the drainage area and the estuarine waters attain almost fresh water conditions during the south-west monsoon season (June to September).

### Collection of specimens

Fresh samples of *Eetroplus suratensis* caught from the estuary as well as fresh fish purchased from landing centre.. A total of 1256 specimens was examined, of which 578 were female, 334 male and 344 were immature. The size range of the fish varied from 5.20 cmt to 23.50 cm TL. Only live specimens were used for physiological studies.

### Energy estimation

Energy content of the dried samples of the whole body of fish, liver, gonad, muscle, skin, fins, head, visceral organs etc., were measured in different stages of maturity using an autobomb automatic adiabatic bomb calorimeter (Model: Gallenkamp, CBA- 305, UK make). The energy values of the tissue are expressed as *kJ/g* dry matter. Energy values of the whole body of fish belonging to the three stages of maturity namely, immature (Stage I < 10 cm TL), maturing (Stage II in the size range of 10-15 cm TL) and mature (Stage III, IV, V & VI with size > 15 cm TL) were, however, determined in different months of the year.

## Results and Discussion

### Proportion of edible and inedible body parts of *E.suratensis* and their energy content

The proportion of different body parts of *E.suratensis* categorized as edible and inedible in immature and mature fish are provided in Table 1. Immature fish as 56.49 % edible and 43.51% of inedible parts in their body. However in the mature fish, male exhibited a higher proportion of edible body parts (61.92%) compared to female (53.92%).

### Energy distribution in different body parts of *E.suratensis*

The percentage distribution of energy in different body parts of fish are given in Table 2. The percentage of energy distribution of different body parts of fish showed that among immature fish, muscle contributed a maximum of 43.64 % while head and visceral organs shared 24.99 % and 12.10 % respectively. The share of energy by skin was 10.27% and that of scales was 4.61%. Fins contributed the least energy (4.38%). Similarly in case of adults also muscle ranked first with female showing 40.59% and male 50.18 %. The second highest energy containing organ was head (female with 31.84% and male with 24.43%) followed by fins in female (9.3%) and skin in male (9.66%). The least energy containing body part in female was scales (5.00%) while in male it was visceral organs (4.11%).

### Proportion of edible and inedible body parts of *E. suratensis* and their energy content

While selecting a species for aquaculture it is desirable to select a species which contains more edible body parts (i.e., after the removal of viscera, fluids, head, scales, fins etc.). Fish

flesh comprises approximately 60% of body weight of fish, varying considerably from species to species (Pigott and Tucker, 1990).

In the present study, *E.suratensis* has been found to possess a high proportion of muscle comparable with those of popular food fishes. As it can be seen from the Table 1, immature fish has muscle comprising 47.62% and mature male and female with 55.34% and 47.09% of the body weight respectively. According to Jobling (1995) gold fish, *Carassius auratus* possesses 40%, salmonids about 60% and scombrids as high as 70% muscle content of body weight. As is generally known, higher the muscle content in fish greater is the demand for it in the market even though taste does play a crucial role. However, it is not just the muscle portion alone that is edible in fish. There are other organs/tissues which are also edible. For instance, liver, gonad etc., depending on their size. Skin, however, is usually consumed along with the underlying muscle tissue after the removal of scales.

Thus, in the present study, even if liver and gonad tissues are discarded along with the other visceral organs, as inedible (as often is the case mostly on account of their small size) the edible portion (muscle tissue plus the overlying adhering skin) in immature fish, yet, amounts to an impressive 56.49%, while in mature male and female the values of edible portion are 61.92% and 53.29% respectively. Thus, it may be stated that *E.suratensis* is a meaty fish whose edible portion showing variation with the size of fish and hence, the maturity condition.

The high proportion of edible body parts in mature male compared to female may be due to the higher portion of visceral organs in female (6.91 %) than in male (3.96%). Miller (1974) reported a value of 47.9% dress-out weight for *Sarotherodon hornorum* and 5.3%

for *S. mossambicus*. Edwardson (1976) found out the edible portion (filleted) of *S.mossambicus* to be at 38%. According to Hickling (1963) the edible portion of *S.mossambicus* varied with the size of the fish and accordingly fish weighing 450g, 700g and 2000g yielded 24%, 27% and 46% of its body weight as edible portion indicating that bigger the fish higher the proportion of edible parts in fish. Edwardson (1976) reported that carp had 53% and trout 70% of its body weight as edible portion. The calorific content of the entire animal is an important variable to be determined in energy flow studies, for its knowledge makes it possible to express dry weights in terms of energy units. Hence, much effort has been made earlier to measure the calorific content of the diet and tissues of many organisms (Slobodkin and Richman, 1961; Paine and Vadas, 1969; Cummins and Wuycheck, 1971 and Jobling, 1995).

Biochemical constituents of animals are known to vary with seasons, size of animals, stage of maturity and the availability of food. These in turn affect the caloric content of the animal (Wootton, 1974; Wootton and Evans, 1976; Wootton 1979; Hunter and Long, 1981). Jobling, (1995) reported that a deposition of 19 lipid (38 kJ) leads to a weight increase of 1g, whereas deposition of 19 protein (24 kJ) also leads to the deposition of 3-4g water. Therefore, changes in weight alone may not always give an accurate reflection of growth in terms of energy gain. Hence, estimation of energy values of fish body can provide the accurate nutritional status of fish.

The distribution / contribution of energy in different body parts of *E. suratensis* showed that muscle tissue contained the maximum energy compared to other body parts. Evidently this must be due to the fact that nutrient rich muscle tissue comprise more than 50% of the body weight of fish.

**Table.1** Proportion of edible and inedible body parts and their energy profile in *Etroplus susratensis*

Maturity stages	Parameters	INEDIBLE PORTION										EDIBLE PORTION			WHOLE
		Head	Pectoral fins	Pelvic fins	Dorsal fins	Anal fins	Caudal fins	Scales	Visceral organs	Vertebral column	Total inedible	Muscle(free of bones)	Skin	Total edible	
<b>Immature</b>	Wet weight(g)	3.7	0.06	0.03	0.21	0.1	0.1	0.27	1.6	0.5	6.57	7.19	1.34	8.53	15.1
	Percent body wet weight (%)	24.5	0.4	0.2	1.39	0.66	0.66	1.79	10.6	3.31	43.51	47.62	8.87	56.49	--
	Energy content(kJ/g dry wt.)	17.47	-	0	11.24*	-	-	17.47	16.43	-	15.65	19.55	15.9	17.47	18
<b>Mature Female</b>	Wet weight(g)	35.73	0.87	0.8	3.66	3	2.2	8.13	10.17	4.17	68.73	69.3	9.13	78.43	147.17
	Percent body wet weight(%)	24.28	0.59	0.54	2.49	2.04	1.5	5.52	6.91	2.83	46.7	47.09	6.2	53.29	--
	Energy content(kJ/g dry wt.)	18.68	-	-	12.80*	-	-	12.28	26.21	--	17.49	20.59	19.81	20.2	18.73
<b>Mature Male</b>	Wet weight(g)	30.93	0.7	9.07	3.8	2.07	2.27	8.07	6.17	4.35	59.43	86.33	10.27	96.6	156
	Percent body wet weight(%)	19.83	0.44	0.69	2.44	1.33	1.44	5.17	3.96	2.79	38.09	55.34	6.58	61.92	--
	Energy content(kJ/g dry wt.)	16.49	-	-	12.28*	-	-	12.8	24.91	--	16.62	19.5	19.79	19.65	17.75

**Table.2** Energy distribution pattern (%) in different body parts of *E.suratensis*

Body parts of the fish	Wet weight (g)	Moisture (%)	Dry matter (g)	Energy density (kJ/ g dry matter)	Total energy (kJ)	% of energy distribution
<b>Immature</b>						
<b>Head</b>	3.91	73.51	1.03	17.47	17.99	<b>24.99</b>
<b>Fins</b>	0.529	47.44	0.28	11.24	3.15	<b>4.38</b>
<b>Scales</b>	0.303	35.20	0.19	17.47	3.32	<b>4.61</b>
<b>Skin</b>	1.481	67.70	0.48	15.39	7.39	<b>10.27</b>
<b>Visceral organs</b>	1.807	70.56	0.53	16.43	8.71	<b>12.10</b>
<b>Muscles</b>	7.62	79.25	1.58	19.55	31.41	<b>43.64</b>
<b>Mature- Females</b>						
<b>Head</b>	52.00	68.81	16.22	18.68	302.99	<b>31.84</b>
<b>Fins</b>	15.80	53.73	7.31	12.80	93.57	<b>9.83</b>
<b>Scales</b>	12.40	68.75	3.88	12.88	47.65	<b>5.00</b>
<b>Skin</b>	11.60	74.62	2.74	19.81	58.24	<b>6.12</b>
<b>Visceral organs</b>	10.00	75.99	2.40	26.21	62.90	<b>6.61</b>
<b>Muscles</b>	93.00	79.83	18.76	20.59	386.27	<b>40.59</b>
<b>Mature- Males</b>						
<b>Head</b>	32.80	66.04	11.14	16.49	183.70	<b>24.43</b>
<b>Fins</b>	8.00	49.64	4.03	12.28	49.49	<b>6.58</b>
<b>Scales</b>	7.00	57.73	2.96	12.80	37.89	<b>5.04</b>
<b>Skin</b>	12.20	69.93	3.67	19.79	72.63	<b>9.66</b>
<b>Visceral organs</b>	5.50	77.46	1.24	24.91	30.89	<b>4.11</b>
<b>Muscles</b>	<b>85.90</b>	<b>77.47</b>	<b>19.35</b>	<b>19.50</b>	<b>377.33</b>	<b>50.18</b>

The second highest energy containing organ is the head which may be attributed to the higher biochemical composition compared to other parts such as fins, scales, skin and visceral organs.

There is paucity of information on bio-energetic studies of Indian fish species. As far as the energy density of edible and inedible parts of *E. suratensis* are concerned immature fish registered a mean value of 17.47 kJ/g in edible parts and 15.65 kJ/g in inedible parts as against 17.49 kJ/g and 18.73 kJ/g in mature female and 19.65 kJ/g and 16.62 kJ/g in mature male respectively.

The lower energy value in inedible body parts of immature fish may be due to the lower energy content of visceral organs probably due to the less developed gonad and liver tissues. In contrast, the energy values of inedible body parts of mature fish were high (26.21 kJ/g in female and 24.91 kJ/g in male) possibly due to the well developed gonad and other organs of high energy value for example liver (27.37 kJ/g each in both sexes) and ovary (21.80 kJ/g).

Pigott and Tucker (1990) reported that a low-fat white fish contains about 80 kcal per 100 g edible portion (raw), medium fat about 100

kcal/100 g and high fat fish between 150 to 225 kcal/100 g (1 calorie = 4.184 J). In the present study, a mature *E. suratensis* is found to contain a very low fat and high protein content. Therefore, it may be considered as an ideal low calorie and protein rich source of food. Wootton (1979) has calculated a mean value of ripe ovaries of 50 teleost species at 23.48 kJ/g dry weight. In the present study also, ripe ovaries of pearl spot have been found to contain almost similar value (21.80 kJ/g dry matter).

The head of pearl spot contained considerable energy ranging from 17.47 kJ/g in immature to 18.68 kJ/g and 16.49 kJ/g in mature female and male respectively. Similarly, other parts of inedible portion also contain considerable energy in them which may be effectively used in feed formulation / manure preparation.

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