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Food utilization and surfacing activity of *Channa striatus* fry in relation to quality of food

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Abstract. Effects of food items (mosquito larva, pupa, chironomous larva and chopped pieces of the fish *Lepidocephalichthyes thermalis*) on food utilization and surfacing activity of *Channa striatus* fry were studied. Test individuals fed on live food organisms surfaced 94–117% more frequently, consumed 23–119% more rations/day and, on an average, converted 33% more than those fed on pieces of *Lepidocephalichthyes thermalis*. Regardless of the quality of food, *Channa striatus* surfaced about 60 times/h before each meal and the frequency increased to 130 times/h 3–6 h after the meal was offered and returned to the prefeeding level 18–21 h after the meal.

Keywords. *Channa striatus* fry; quality of food; food utilization; surfacing activity.

1. Introduction

Culture of air-breathing fishes is gaining much importance in tropical fisheries due to high demand for these fishes. Though sturdy as adults, the fry of the obligatory air-breathing fish *Channa striatus* have low survival rate and hence, pose considerable problems to fish culturists. Non-availability of suitable food organisms and lack of favourable conditions during the development of the air-breathing organ are the two major reasons for high mortality rate of fry of air-breathing fishes (Pandian 1980). As an attempt to select suitable food, fry of *C. striatus* were offered with 4 live food organisms, chopped pieces of the fish *Lepidocephalichthyes thermalis* and the pattern of food utilization and surfacing activity was studied.

2. Materials and methods

Active and well acclimated *C. striatus* fry weighing $308{\cdot}5 \pm 25{\cdot}91$ mg were randomly chosen and divided into 5 series. Four replicates were maintained for each series. The first 3 series were fed on mosquito larva or pupa, the IV series on chironomous larva and the V series on chopped pieces of the fish *L. thermalis*. Chironomous larvae were collected from the field every day, starved for 24 h and then served as food. *Culex* mosquito egg raft was collected from the field regularly, hatched and reared in the laboratory up to 4th instar or pupa (Ponniah and Pandian 1977). Third and fourth instar larvae of *Anopheles* were collected directly from the field and offered as food. *L. thermalis* was maintained separately in aquaria and were starved for 24 h before being offered as food. Food was offered twice a day at 0900 and 1900 h for a period of 1 h each; unconsumed food was collected by a pipette without disturbing the test animals.

Experiments were conducted in cylindrical aquaria (5 cm dia) containing constant depth of water (15 cm). Faecal matter was collected by filtering the aquarium water daily before changing water. Sacrifice method was followed to estimate the initial water and energy contents of the test fish. Energy content was estimated in a Parr 1412 semi-micro bomb calorimeter. The scheme of energy budget followed in the present study is that of IBP formula (Petrusewicz and Macfadyen 1970) represented as $C = P + R + U + F$ where C is the energy consumed, P the growth, R the energy lost as heat due to metabolism, F the faeces and U the nitrogenous waste. Estimation of various energy components has been detailed elsewhere (Sampath and Pandian 1980).

Number of surfacing by each test individual was observed everyday for a known period of time (15 min) during the following timings: 3, 6, 9, 12, 15, 18, 21 and 24 h after feeding. The distance travelled per individual was estimated by multiplying the mean number of visits per unit observations with twice the depth of water. Experiments were conducted for a period of 21 days at a room temperature of 28 ± 2°C.

3. Results

Of the 5 test series, the one fed on *Anopheles* larva exhibited the highest rates of feeding, absorption, metabolism and conversion (table 1); these rates were statistically significant compared to the corresponding rates of fry fed on other test series. The series fed on pieces of *L. thermalis* exhibited the lowest rates of feeding, absorption and metabolism. Test individuals fed on live food organisms surfaced 94–117% more frequently, consumed 23–119% more ration and, on an average, converted 33% faster than those fed on pieces of *L. thermalis*. Contrary to this, absorption efficiency did not vary much among the test series and averaged to 90·4%.

Table 1. Effects of different food materials on food utilization and surfacing activity in *C. striatus*.

Parameter	*Anopheles* larva	*Culex* pupa	*Culex* larva	*Chironomous* larva	Pieces of *L. thermalis*
Feeding rate	1895 ± 134·9	1382 ± 176·7	1069 ± 97·7	1122 ± 58·7	868 ± 172·9
Absorption rate	1706 ± 141·1	1227 ± 165·4	963 ± 105·8	1054 ± 59·2	817 ± 213·5
Conversion rate	666 ± 75·3	444·1 ± 64·5	291 ± 35·9	288 ± 36·0	318 ± 68·9
Metabolic rate	936 ± 59·9	703 ± 108·7	605 ± 69·3	690 ± 4·4	432 ± 128·5
Absorption efficiency	89·5 ± 1·30	88·7 ± 0·75	90·1 ± 1·05	94·0 ± 0·41	90·0 ± 2·75
Conversion efficiency(K_2)	38·9 ± 1·27	36·4 ± 2·70	30·5 ± 6·85	27·3 ± 1·84	37·2 ± 5·10
Surfacing frequency/day	2196 ± 315·0	2052 ± 286·2	1962 ± 244·8	2106 ± 201·6	1010 ± 114·0
Hanging duration	3·0 ± 0·25	3·3 ± 0·26	3·0 ± 0·13	2·9 ± 0·38	—
Distance covered	539 ± 74·90	508 ± 63·50	577 ± 82·60	549 ± 51·75	222 ± 25·10

Each value represents the average (± SD) performance of 4 individuals at 28 ± 2°C. Rates are expressed in J/g live fish/day, efficiencies in percentage; hanging duration and distance covered are expressed as h/day and m/day, respectively.

Conversion efficiency ranged from 27·3% (series fed on Chironomous larva) to 38·9% (series fed on *Anopheles* larva) and averaged to 34·1%.

The series fed on live food organisms surfaced twice (average: 2079 times/day) as frequently as the series fed on *L. thermalis* pieces (1010 times/day); correspondingly, the distance covered to surface increased by nearly 2·5 times. After undertaking a few surfacings, *C. striatus* resorts to a short resting period in water surface called hanging. In the present experiment, the duration of hanging did not change in any of the test series and remained around 3 h/day (table 1).

Hourly fluctuation in surfacing frequency following a meal was observed in the test series fed on live organisms. This study was conducted during the last 3 days of the experiment over a 24 h cycle. The test individuals surfaced about 60 times/h before feeding and the frequency increased to about 130 times/h, 3–6 h after the meal in the series fed on *Anopheles* larva and decreased thereafter to the prefeeding level 21 h after each meal (figure 1). Vivekanandan *et al* (1977) have reported similar trend in the surfacing frequency following meal in another obligatory air-breathing fish *Anabas scandens*.

4. Discussion

The test series which were offered 4 different live food organisms exhibited statistically significant difference in food utilization parameters, viz rates of feeding, absorption, conversion and metabolism as compared to those fed on pieces of *L. thermalis*.

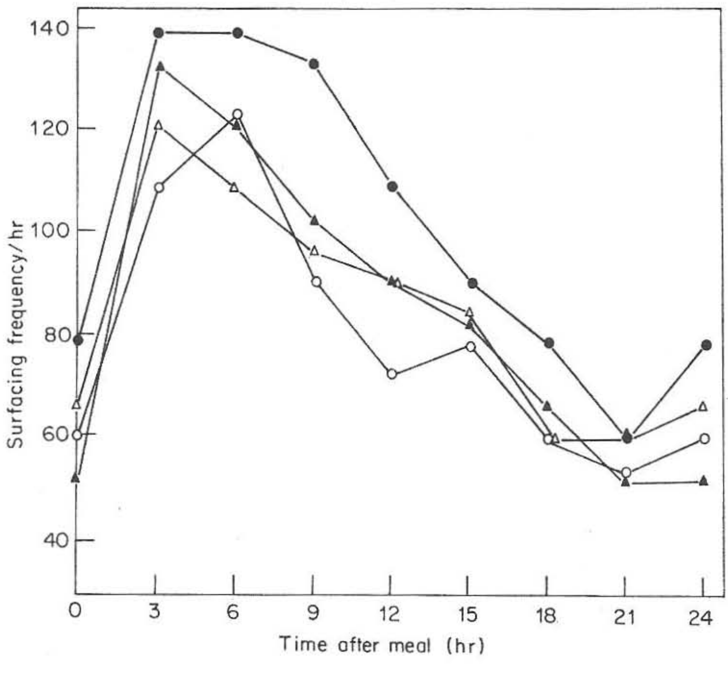

Figure 1. Hourly fluctuation in the surfacing frequency/h as a function of time after meal in *C. striatus* fed on different live food organisms (●), *Anopheles* larva; (△), *Culex* pupa; (○), *Culex* larva; (▲), Chironomous larva.

Table 2. Water content and caloric value of different food materials and experimental fish.

	Food		Fish	
Food	Water content (%)	Caloric value (kJ/g dry wt)	Water content (%)	Caloric value (kJ/g dry wt)
Anopheles larva	83·4 ± 8·20	21·7 ± 0·51	76·7 ± 0·69	19·7 ± 0·57
Culex pupa	88·7 ± 7·50	21·0 ± 0·90	77·5 ± 1·01	19·0 ± 0·85
Culex larva	88·0 ± 7·90	22·1 ± 0·77	77·0 ± 0·87	19·4 ± 0·61
Chironomous larva	84·6 ± 7·50	23·1 ± 0·90	76·7 ± 0·17	19·7 ± 0·54
L. thermalis pieces	80·0 ± 6·70	19·5 ± 0·28	79·2 ± 0·69	19·5 ± 0·57

This result provides clues on the possible strategies adapted by *C. striatus* when exposed to different food items: (i) when exposed to low energy food *L. thermalis* (19·5 kJ/g dry wt; table 2), *C. striatus* reduces the feeding rate and compensates by decreasing the surfacing frequency and alloting less energy for swimming activity and metabolic rate, (ii) the high feeding rate in the series fed on *Anopheles* larva might have resulted from a behavioural synchronisation of the properties of the predator and prey. *Anopheles* larva stays at the water surface most of the time and, while surfacing, *C. striatus* encounters *Anopheles* larva more frequently than other food organisms. This synchronisation might have resulted not only in higher feeding and conversion rates but also in the least allocation of ingested energy towards metabolism, and (iii) there is no evidence of changes in feeding, absorption and conversion rates and surfacing activity among the series receiving live food organisms in relation to the minor variation in the energy content. However, the series receiving the lowest food energy (*L. thermalis*) consumed the least ration. As the conversion rate of the series fed on *Anopheles* larva (666 J/g/day) was substantially faster than the rates exhibited by the other series (288–444 J/g/day), it may be advantageous to feed *C. striatus* fry on live food organisms which remain at the water surface.

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