

Diurnal Variations in the Oxygen Uptake of the Juveniles of Indian Major Carps

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Oxygen uptake studies in *Catla catla* (Hamilton), *Labeo rohita* (Hamilton) and *Cirrhinus mrigala* (Hamilton) showed peak O_2 uptake ($mg O_2 g^{-1} hr^{-1}$) at 03, 09 and 15 hr in *C. catla* (0.74, 0.73 and 0.74 respectively) and *C. mrigala* (1.01, 1.14 and 1.12 respectively) and at 00 and 12 hr in *L. rohita* (1.09 and 1.25 respectively). Analysis of variance showed significant difference in O_2 uptake of these species. Oxygen uptake during 24 hr period, during day and during night in *C. catla*, *L. rohita* and *C. mrigala* showed the following ratios: 1:1.36:1.40; 1:1.39:1.49 and 1:1.32:1.30, respectively.

Key Words: O_2 Uptake, Juveniles, Indian Major Carps

Introduction

Mixed species culture with Catla, Rohu and Mrigal is undertaken on an extensive scale in India (Jhingran 1975). Though there are reports available on oxygen uptake in these species, no such studies have been reported for the early Juveniles, which is being attempted here. The information on the changes in O_2 uptake during different hours of the day could be usefully employed in planning a feeding schedule with supplementary feeds for these culturable species.

Materials and Methods

Early Juveniles of *Catla catla* (Hamilton), *Labeo rohita* (Hamilton) and *Cirrhinus*

mrigala (Hamilton) of 25 mm SL were purchased from the hatcheries at Manchikalapudi, Andhra Pradesh; where they were obtained through induced breeding. The Juveniles were acclimatized in laboratory for 10 days and were fed on a mixture of coconut oil cake and rice bran (1:1).

Fish were acclimatized in the experimental chambers—2 L capacity which were designed after Jones (1964)—for a period of 6 hr prior to the commencement of experiments. For each observation the experimental chamber was closed for 2 hr in view of the much small size of the animals. Initial and final values of oxygen

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in the chamber were recorded by modified Winkler's method (Golterman & Clymo 1969). The total period of observations covered 8 hr each during day and night, with equal intervening periods between the observations i.e., at 00, 03, 06, 09, 12, 15, 18 and 21 hr. The average values are based on three replicates.

Analysis of variance test (Bailey 1975) was employed to study the difference in O_2 uptake among the three species (i) in 24 hr and (ii) during each observation. If the test showed statistically significant difference, the data were further analysed by employing 't-test'.

Results

In *C. catla*, the O_2 uptake ranged ($mg O_2 g^{-1} hr^{-1}$) between 0.57 ± 0.25 and 0.74 ± 0.12 ; the average being 0.66 ± 0.14 . There were three peaks of O_2 uptake during 24 hr period two during day at 09 and 15 hr and one during night at 03 hr. O_2 uptake was minimum at 06 and 18 hr (figure 1).

In *L. rohita*, the O_2 uptake ranged ($mg O_2 g^{-1} hr^{-1}$) between 0.65 ± 0.15 and 1.25 ± 0.08 ; the average being 0.897 ± 0.22 . There were two peaks of O_2 uptake during 24 hr—one at 12 hr and the other at mid night. O_2 uptake was minimum at 06 and at 21 hr (figure 1).

In *C. mrigala* the O_2 uptake ranged ($mg O_2 g^{-1} hr^{-1}$) between 0.63 ± 0.22 and 1.22 ± 0.19 ; the average being 0.92 ± 0.24 . There were three peaks of O_2 uptake during the 24 hr—two during day at 09 and 15 hr and one in the night at 03 hr. O_2 uptake was minimum at 06 and 18 hr (figure 1).

Analysis of variance test applied to the data in the 24 hr period showed significant differences in O_2 uptake among the three species ($F = 6.63$), suggesting a species specific O_2 uptake (table 1). The average O_2 uptake in the 24 hr period in

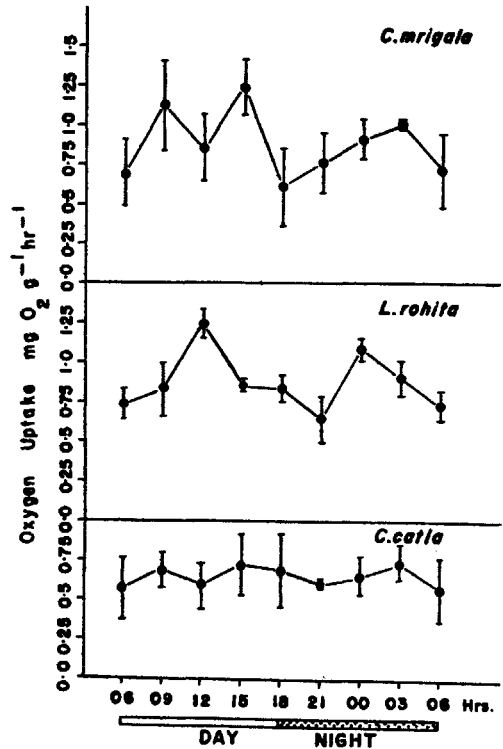


Figure 1 Diurnal variations in oxygen uptake in *C. catla*, *C. mrigala* and *L. rohita*

Juveniles of *C. mrigala* was more than those of *L. rohita* and *C. catla*. Of the three *C. catla* consumed the minimum.

At each observation period the data were subjected to the 'F-test' (table 2). (Further analysis was made by employing 't-test'). The results showed that at 00, 03, 09, 12 and 15 hr there was a significant difference in O_2 uptake between the species. The 't-test' shows statistically significant difference at 00 hr between *L. rohita* and *C. catla* only; at 03 hr between *C. catla* and *C. mrigala* and between *C. catla* and *L. rohita*; at 09 hr between *C. catla* and *C. mrigala* only; at 12 hr between *C. catla* and *L. rohita* and between *L. rohita* and *C. mrigala* and at 15 hr between *C. mrigala* and *C. catla* (table 3).

Table 1 Analysis of variance test for 24 hr period

Source of variation	Degree of freedom	Sum of squares	Mean square	Variance ratio
Species	2	0.28836	0.14418	6.6317*
Period	7	0.29448	0.042068	1.9349
Residual	14	0.30438	0.021741	
Total	23	0.88722		

*Significant; D.F. $f_1=2$ and $f_2=14$

Table 2 Analysis of variance test at each time of observation

Time (hr)	<i>C. catla</i>		<i>L. rohita</i>		<i>C. mrigala</i>		F. Value*	Remarks
	Mean**	SD	Mean**	SD	Mean**	SD		
00	0.72	0.06	1.09	0.06	0.93	0.13	12.53	Sig.
03	0.74	0.12	0.93	0.09	1.01	0.06	13.53	Sig.
06	0.58	0.19	0.74	0.09	0.71	0.22	1.36	NS
09	0.73	0.10	0.83	0.17	1.14	0.27	6.28	Sig.
12	0.61	0.14	1.25	0.08	0.85	0.21	13.57	Sig.
15	0.74	0.18	0.86	0.05	1.22	0.19	7.60	Sig.
18	0.57	0.25	0.84	0.09	0.63	0.22	1.49	NS
21	0.67	0.01	0.65	0.15	0.77	0.18	1.25	NS

* Degree of freedom— $f_1=2$ and $f_2=6$

** Units = $\text{mg g}^{-1} \text{hr}^{-1}$

Table 3 Results of 't-test'

Time (hr)	't'-values			Degree of freedom
	<i>C. catla</i> / <i>L. rohita</i>	<i>C. catla</i> / <i>C. mrigala</i>	<i>L. rohita</i> / <i>C. mrigala</i>	
00	7.63*	2.41	2.01	4
03	3.34*	5.43*	1.32*	4
09	0.723	2.72*	1.96	4
12	6.96*	1.65	3.10*	4
15	1.15	3.14*	3.07	4

* Significant at 4 degree of freedom at 0.05 probability

Discussion

Diurnal variations in biological parameters is a known phenomenon (Prosser 1973). Usually the rhythmic variation is maintained constant in the absence of any environmental stress and is related to the in-built activity of the organism (Brown 1973). The peaks in that rhythmicity indicate the active periods in relation to that parameter whereas the minimal values account for low activity periods.

Present studies indicate that among the three major carp Juveniles, *C. catla* and *C. mrigala* show two peaks of O_2 uptake during the day at the same periods and of almost similar intensity, while *L. rohita* shows only one peak. During night all the three species have only one peak but at different times (figure 1). No earlier data on carps is available for comparison. In the Indian climbing perch, *Anabas scandens* there are two peaks—one in the morning hours and one during night (Reddy & Natarajan 1970).

The percentage O_2 uptake during day (observation period 8 hr) and during night (observation period 8 hr) in the total O_2 uptake in 24 hr period (observation period 16 hr) is different between the three species. In *C. catla* the uptake during day is 50.12% of the total uptake while in *L. rohita* it is 51.27% and in *C. mrigala* it is 53.39%. The ratio in total O_2 uptake between *C. catla*, *L. rohita* and *C. mrigala* during the total experimental period, during day and during night is as follows:

1:1.36:1.40; 1:1.39:1.49 and 1:1.32:1.30 respectively. This shows that both *L. rohita* and *C. mrigala* have a higher rate of O_2 uptake than *C. catla* during all periods, while during day the uptake of O_2 of *C. mrigala* is more than *L. rohita*.

The present study shows that of the three species studied, the period of activity coincide in Juveniles of *C. catla* and *C. mrigala* more closely than with *L. rohita*. It is suggested that these data could be utilized while planning a feeding schedule of supplementary feeding of different carps in mixed culture.

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References

- Bailey N T J 1975 *Statistical Methods in Biology* (Britain: ELBS) 200 pp.
- Brown F A Jr 1973 Biological Rhythms; in *Comparative Animal Physiology* pp. 429-456 ed. C L Prosser (London: W B Saunders Co.)
- Golterman N and Clymo 1969 *Methods for Chemical Analysis of Freshwaters* (Blackwell Sci. Publ.) 166 pp
- Jhingran V G 1975 *Fish and Fisheries of India* (New Delhi: Hindustan Publ. Corp., India) 954 pp.
- Jones J R E 1964 *Fish and River Pollution* (Butterworth & Co.) 203 pp.
- Prosser C L 1973 Oxygen: Respiration and Metabolism; in *Comparative Animal Physiology* pp. 165-211 ed. C L Prosser (London: W B Saunders Co.).
- Reddy T G K and Natarajan G M 1970 Studies on the respiration of *Anabas scandens* (Cuv.); *J. Annamalai Univ. Sci.*, **28** 155-162