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Seasonal variations in the bimodal oxygen uptake in *Clarias batrachus*

Anupam Kumari* & M. Rauf Anwer
P.G. Department of Zoology, Purnea College, Purnea, B.N. Mandal University, Madhepura, Bihar, India

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Abstract: In the present work an attempt has been made to study bimodal oxygen uptake in relation to body weight and sex in freshwater siluroid fish, *Clarias batrachus* (Linn.). Among most aquatic air breathers O_2 uptake is divided between air and water fraction given to each mode varies depending on physical conditions such as aquatic O_2 tension and temperature. The percentage of aquatic: aerial O_2 uptake were 55.45 in June while these values were 74.78: 25.22 in December. Similarly aquatic/aerial quotient values were 1.22 in June and 2.96 in December. E.E.U. values were 0.025 K. cal/h in June and 0.005 kcal/h in December.

Keywords: Seasonal variations, bimodal oxygen, uptake, *Clarias batrachus*

INTRODUCTION

Air-breathing fishes, inhabiting tropical freshwater ponds, lakes and rivers employ two modes of respiration namely aquatic respiration using gills and aerial respiration using highly vascularised air-breathing organs. The fishes depend on aquatic and aerial respirations to different degrees in relation to their environmental conditions and the efficiency of their respiratory organs. The relative importance of the two modes of respiration differs in obligate and facultative air breather which is reflected structurally as well.

Though the patterns of bimodal oxygen consumption has been investigated in a number of air-breathing fishes, the number of species so far explored appears too small compared to the total member of species (about 140) of air-breathing fishes available. A wide survey of respiratory patterns in these unexplored species is considered profitable contributing to our better understanding of the pattern of bimodal respiration and the relative importance of aquatic and aerial gas exchange in these fishes.

*Corresponding author :
Phone : 8209368113
E-mail : annujha2@gmail.com

The metabolic rate, as expressed in terms of oxygen consumption in fishes, is influenced by a number of factors. The knowledge about the structure and respiratory surface areas of the gills, the blood water barriers, diffusion capacity and the structural modifications in these parameters with respect to the habitat of fish will certainly throw some light on the adaptation of respiratory mechanism of fishes to a variety of environment. Such information's are of prime Importance for better understanding of the respiratory physiology of any particular species of fish. The fresh water air breathing fishes of tropical countries inhabit waters of low O_2 and high CO_2 contents. Moreover, the pools, ponds, swamps, creeks and also the torrential streams inhabited by them often after dry out during summer or their water becomes muddy, highly hypoxic and hyperbaric which is unsuitable for gaseous exchange across the gills. Under such unfavourable environmental conditions, these fishes depend on aerial respiration alone until the commencement of the next rainy season. However, while some fishes resort to air breathing only under adverse conditions, others such as the climbing perch adopt bimodel respiration even in normoxic water. The adaptive features of the air-breathing fishes inhabiting hypoxic and hypercarbic waters have been described by Carter (1957)[1] and Johansen (1970)[2] anal several others Until later 1950, much attention was paid to the structural modifications and adaptations of air breathing fishes.[3,4]

In the present work an attempt has been made to study bimodal oxygen uptake in relation to body weight and sex in freshwater siluroid fish, *Clarias batrachus* (Linn.).

Among most aquatic air breathers O, uptake is divided between air and water fraction given to each mode varies depending on physical conditions such as aquatic O_2 tension and temperature.

MATERIALS AND METHODS

The live specimens of *Clarias batrachus* (Linn) were procured from local fish dealers at Purnea (Bihar) and were transported and acclimatized in the laboratory conditions for ten days in big glass aquaria. The fishes were fed on pieces of goat liver; small prawns and earthworms, daily at 11.00 a. m. during a minimum acclimatization period of ten days in the laboratory. They were kept fasting for 24 hrs before experiments. No feeding was done during the experiment. Five fishes from each w group were selected for measuring the oxygen consumption Bimodal oxygen consumption from air and still water was measured in a closed glass respirometer containing 8L. water (0, content 6.22-6.5 mg/1; pH 7.22-7.3) and 01.51 of air.

Live specimens of *C. batrachus* (weight range - 55-659; Av 60g) were procured from local fish dealers in the first week of every month for a period of twelve months. They were maintained in large glass aquaria for a week for acclimatization before use for experimental work. The fishes were fed daily on pieces of goat liver, earthworms and fish meal. The fishes were kept fasting for 24 hours before experiment. No feeding was done during experiment.

The datails of the methods employed in the study of biomodal oxygen uptake from air and still water has already been discussed in earlier para graphs. The concentration of dissolved oxygen in the water was estimated by Winkler's volumetric method.[5]

Linear relationship between ambient water temperature and day length vs. bimodal oxygen uptake from air and still water was established on the basis of available data using the general equation Y = a + bx. Here Y stands for oxygen uptake from air and still water X is the independent variables (temperature and day length). b = slope of the regression line and is the intercept i.e. value of oxygen uptake at 1 degree centrigrade or 1 hr. day length O_2 (change per 10 degree centigrade rise in temperature) value for oxygen uptake from air and still water were calculated by the following formula.

$$\log Q_{10} = \frac{(\log M_2 - \log M_1)}{T_2 - T_1}$$

Where M_1 and M_2 are VO_2 at temperature T_1 and T_2 respectivley.

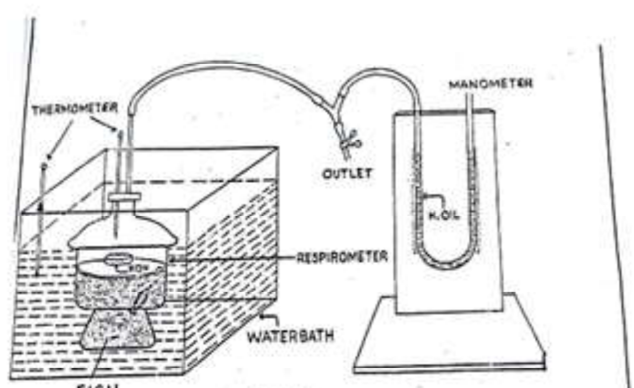

FIG.1

Fig I : Experimental set up for the measurement of bimodal oxygen uptake in *Clarias batrachus* (Linn.)

RESULTS AND DISCUSSION

The data showing av. water temperature (°C), av. day length (h), aquatic, aerial, total O_2 uptake (mlo,/h & cc/kg/h). percentage of aquatic and aerial O, uptake, aqautic/aerial quotient and E E.U. in different months of the year in *C. batrachus* are summarised in Table 1.

The aquatic, aerial and total NO, uptake showed wide range of variations in different months of the year. These values were minimum being respectively 0.838, 0.283 and 1.121 amlo/h (or 18.62, 6.28 & 24.90 cc/kg/h) in December and maximum being respectively 2.888. 2.363 & 5.251 mlo,/h (or 64.18. 52.51 and 116.69 cc/kg/h) in June. The O_2 uptake values were higher during summer & breeding season while these values were lower during winter and nonbreeding periods.

The percentage of aquatic : aerial O_2 uptake were 55.45 in June while these values were 74.78: 25.22 in December. Similarly aquatic/aerial quotient values were 1.22 in June and 2.96 in December. E.E.U. values were 0.025 K. cal/h in June and 0.005 kcal/h in December.

Table 1- Seasonal variation in bimodal oxygen uptake, percentage of aerial and aquatic in *Clarias batrachus*

Sl. N0.	Months	Water Temp. 0C	Day length (n)	Oxygen Consumption						Percentage		Aquatic	EEU Kcal/h
				Aquatic		Aerial		Total		Aquatic	Aerial		
				ml/h	Cc/kg/h	ml/h	Cc/kg/h	ml/h	Cc/kg/h				
1	January	22.0	10.29	0.922	20.49	0.321	7.13	1.243	27.62	74.18	25.82	2.87	0.006
2	February	23.5	10.59	1.710	38.00	0.632	14.04	2.342	52.04	73.02	26.98	2.71	0.011
3	March	25.5	11.29	2.574	55.96	1.210	26.30	3.784	82.26	68.02	31.98	2.13	0.018
4	April	29.5	12.29	2.605	57.89	1.737	38.60	4.342	96.49	60.00	40.00	1.50	0.021
5	May	31.0	13.14	2.861	62.19	2.248	48.89	5.109	111.08	66.00	44.00	1.50	0.024
6	June	32.1	13.29	2.888	64.18	2.363	52.51	5.251	116.69	55.00	45.00	1.22	0.025
7	July	30.0	13.14	2.421	51.56	1.422	30.25	3.843	81.81	63.00	37.00	1.70	0.018
8	August	30.0	12.44	1.790	39.78	0.964	21.42	2.754	61.20	65.00	35.00	1.86	0.013
9	Sept.	29.0	12.14	1.637	36.38	0.889	19.75	2.526	56.13	64.81	35.19	1.84	0.012
10	Oct.	29.5	11.14	1.716	36.51	1.051	23.51	2.767	60.02	62.02	37.98	1.63	0.013
11	Nov.	25.0	10.29	1.603	35.62	0.673	14.95	2.276	70.43	70.43	29.57	2.38	0.011
12	Dec.	19.0	10.14	0.838	18.62	0.283	6.28	1.121	74.78	74.78	25.22	2.96	0.005

REFERENCES

1. **Carter, G.S. 1957.** Air breathing. In "The physiology of Fishes" (Ed. M.E. Brown) vol. I. pp. 65, *Academic Press Inc., New York*, London and San Francisco.
2. **Johansen, K. 1970.** Air breathing in fishes. In "Fish physiology" (Eds. W.s. Hoar and D.J. Randall) vol. **IV**. pp. 361-411. *Academic press, New York*, London and San Francisco.
3. **Das, B.K. 1927.** The bionomics of certain air breathing fishes of India, together with an account of the development of their air breathing organs. *Phil. Trans. Roy.Soc. Lond.* **216:** 183-219.
4. **Das, B.K. 1933.** On the bionomics, structure and physiology of respiration in an estuarine air breathing fish *Pseudopocryptes lanceolatus* with special reference to a new mode of aerial respiration. *Curr. Sci.* **1:389-393**
5. **Winberg, G.G. 1956.** Rate of metabolism and food requirement of fishes. Fish. *Research Bd. Canada Trans Ser*. **194:**1-253.

ADDITIONAL REFERENCES

1. **APHA, AWWA and WPCF. 1971.** Standard method for the examination and waste water, 13th ed, American Public Health Association *Inc., New York.*
2. **Arora, H.C., Sharma, V.P. and Chattopadhaya, S.N. 1971a.** Bioassay studies of some commercial organic insecticides. Trials of malathion with exotic and indigenous carps. *Indian J.Environ. Health.* **13:** 4.
3. **Arora, H.C., Srivastava, S.K. and Seth, A.K. 1971b.** Bioassay studies of some commercial organic insecticides. Studies with an exotic carp *Puntius sophore* (Ham.) *Indian J. Environ*. Health 13, 3.
4. **Baraduc, M.M. 1954.** *Comp. rend. acad. Sci*. J. **238:**7285-730.

5. **Chanchal, A.K., Pandey, B.N., Singh, S.B. and Prasad, S. 1979.** Cyclic changes in values of A. testudineus. *The Annals of Zoology*: **15(3):** 111-124.

6. **Vanoordt G.J. 1963.** Quoted In "Comparative endocrinology" Edited by U.S. Von. Euler and H. Heller vol.**1.**

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