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EFFECT OF BENZOCAINE ON OPERCULAR MOVEMENT AND OXYGEN CONSUMPTION IN *CHANNA PUNCTATUS* (BLOCH)

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ABSTRACT

Effect of anaesthetization with benzocaine @ 18.0mg.1^{-1} on juveniles of *Channa punctatus* was observed using a cylindrical glass respirometer. Oxygen consumption and opercular movement were studied at 3h and 24h of anaesthetization. The oxygen consumption of control fish increased linearly from 0.183$\pm$ 0.029 to 0.481$\pm$ 0.034 $mlO_2.h^{-1}$ with an increase in body weight from 1.45$\pm$0.18to 6.12$\pm$0.11g and showed a reduction ($p<0.001$) of about 41% in 3h and 37% in 24h anaesthetization of Benzocaine. Similarly, the opercular movement of control fish ranging between 46$\pm$1to 49$\pm$1min^{-1} came down to show a reduction ($p<0.001$) of 43% and 38% respectively in 3h and 24h anaesthetization. The information is useful in calculation of oxygen requirement of this species for live transportation and other experimental purpose.

Keywords : Benzocaine, Anaesthetic, Oxygen consumption, Opercular movement, *Channa punctatus*

INTRODUCTION

The anaesthetics are soothing medicines whose application reduces the rate of oxygen consumption, release of carbon dioxide along with excretory products and control excitability of the fish. Different aspects of anaesthetics have been studied by various workers (Laird and Oswald, 1975; Ross and Ross, 1984; Sharma *et al.*, 1991; Basavaraju *et al.*, 1998; Venkateshwarlu and Pal, 2003; Pal *et al.*, 2005). The anaesthetics change the physiological behaviour of fish but related information is limited (Mc Farland, 1959; Houston *et al.*, 1971).

Anaesthetization with benzocaine on oxygen uptake in Indian major carps has been reported (Basavaraju *et al.*,1998; Jha *et al.*, 2004). Such information on Indian air-breathing fishes is fragmentry (Pandit and Ghosh, 1999). *Channa punctatus* (Bloch), commonly known as snake-headed murrel is an air-breathing fish treated as table fish in many states of India but not uniformly distributed. Therefore, this study will help to formulate a transportation aid for this species.

MATERIAL AND METHODS

Juveniles of *Channa punctatus* were collected from Aquarium House of

University Department of Zoology, Bhagalpur. They were fed with trash fish and chopped goat liver during acclimation. To determine an optimum dose of benzocaine (=Ethyl-p-aminobenzoate), ten isomorphic specimens were kept separately in plexiglass aquaria (30 x 30 x 30 cm) having different doses (10.0 to 25.0 mg. l^{-1}) of unbuffered anaesthetic solution. Response of fish to the anaesthetic was observed up to 96 hours and duration of complete sedation was recorded. The stage of complete sedation is known as I(2) deep sedation stage (Mc Farland, 1960).

The oxygen comsumption of *Channa punctatus* in control and sedated (=anaesthetized) conditions was determined by using cylindrical glass respirometer (Ghosh and Munshi, 1987) at 19.5 ± 1.0^{0}C. The amount of dissolved oxygen in water was estimated by Winkler's volumetric method (Welch, 1948). The opercular movement was counted by visual observations.

The results have been presented in mean $\pm$ standard deviation. Data was analyzed using 123 software to detect statistical significance at $p<0.001$.

RESULTS AND DISCUSSION

A dose of 18.0mg.l^{-1} of benzocaine was found suitable to anaesthetize *C. punctatus* of weight range 1.0 to 6.5 g (Total length: 5.3 to 8.5cm.). A dose of 30.0 to 500.0mg.l^{-1} of benzocaine is used to anaesthetize salmonids, tilapia, cat fish and carps (Ross and Ross, 1984; Basavaraju *et al.*, 2004). The dose of benzocaine of *Channa* is thus lower than the range of dose for other fishes. The difference is perhaps related to the species and body weight of fish as well as experimental temperature.

When control specimens of *Channa* were introduced in the aquarium, they appeared more active than the anaesthetized specimens. They showed erratic movement due to a new environment as well as effect of handling. They settled down at the bottom of aquarium in about half an hour. On the other hand, anaesthetized fish showed settling within fifteen minutes. The anaesthetized group showed some loss of reactivity to external stimuli and reduction in opercular movement to represent I(2) deep sedation stage of fish (Mc Farland,1960).

The aquatic oxygen consumption of control *C. punctatus* increased almost smoothly from 0.183 ± 0.029 to 0.481 ± 0.034 ml O_2h^{-1} with an increase in body weight from 1.45 ± 0.18 to 6.12 ± 0.11 g (Table 1). While, the oxygen consumption of 3h and 24h benzocaine anaesthetized fish of above weights showed an increase of 0.096 ± 0.015 to 0.286 ± 0.023 and 0.105 ± 0.017 to 0.037 mlO_2h^{-1} respectively (Table1). The 3h anaesthetized fish thus showed 40.94% reduction ($p<0.001$, $r=0.997$) in oxygen consumption in comparison to control group but the decrease was 37.43% ($p<0.001$, $r=0.995$) in 24h anaesthetization. While working with effect of 3h and 24h anaesthetization with benzocaine on oxygen consumption in *Heteropneustes (=Saccobranchus) fossilis,* Pandit and Ghosh (1999) observed a reduction of 75% and 46% respectively. The reduction is more pronounced in *H. fossilis* in comparison to *C. punctatus*. The difference is perhaps due to relative proportions of respiratory center. The explanation corroborates with the report of Munshi and Hughes (1992) in which they described a smaller respiratory center in *C. punctatus* when compared to *H. fossilis*. Recently Jha *et al.*, (2004) reported a reduction of 39.54% and 37.21% in oxygen consumption respectively in 2h and 24h anaesthetization with benzocaine in *Catla catla* but the reductions were 43.85% and 35.25% in *Labeo rohita.* Therefore, it may be suggested that benzocaine certainly decreased the rate of oxygen consumption but the percentage of reduction depends on weight group and species of fish, duration of anaesthetization, dose of anaesthetic and experimental temperature.

The opercular movement of control *C. punctatus* ranged between 46 ± 1 to 49 ± 1 min^{-1} lowered in a web like manner (Fig 1) from 24 ± 2 to 29 ± 1 and 27 ± 2 to 31 ± 3 min^{-1} respectively in 3h and 24h anaesthetized individuals, 42.55% reduction ($r=0.994$) in 3h and 38.30% ($r=0.952$) in 24h anaesthetization was highly significant ($p<0.001$). Pandit and Ghosh (1999) observed 57% and 29% reduction in opercular movement in 3h and 24h benzocaine anaesthetized *H. fossilis.* A reduction of 42% and 33% in *C. catla* but 48% and 35% in *Labeo rohita* in their corresponding opercular movement was reported by Jha *et al.*, (2004) in 2h and 24h anaesthetization of benzocaine. These findings are in line with present observation. But, Mishra *et al.*, (1994) studied the effect of urea (1% and 2%) in *C. punctatus* and reported opercular movement 36 ± 4 min^{-1} in control but 42 ± 4 and 37 ± 5 min^{-1} respectively. It seems that deviation in opercular movement under control and experimental conditions is related with stages of life cycle and species of fish, temperature, nature and concentration of experimental substance and duration of treatment.

It was observed that the reduction both in oxygen consumption and opercular movement was more pronounced in 3h exposure when compared to 24h exposure of benzocaine (Table-1). The difference in reduction is perhaps due to certain degree of short term adaptation of fish. When fish are introduced in anaesthetic solution, they secrete copious amount of mucus which enhances water blood barrier to reduce oxygen uptake. Goel Sastri (1995) described that anaesthetic causes a decrease in the response for

Table 1: Opercular movement and oxygen consumption in control and benzocaine anaesthetized *Channa punctatus* at 19.5±1^{0}C.

	CONTROL		3h EXPOSURE		24h EXPOSURE	
Average wt. of a fish (g) (n=3)	Opercular movement (min^{-1})	Oxygen consumption $m1O_2kg^{-1}.h^{-1}$	Opercular movement (min^{-1})	oxygen consumption $mlO_2kg^{-1}.h^{-1}$	Opercular movement (min^{-1})	oxygen consumption $mlO_2kg^{-1}.h^{-1}$
1.45+0.18	47+2	120+20	24+2	66+10	72+2	72+12
2.23+0.09	48+2	110+17	28+2	64+10	30+2	69+11
2.82+0.25	47+1	96+12	27+2	56+15	30+2	62+11
3.15+0.17	48+3	98+27	29+1	57+16	28+1	62+10
3.77+0.20	49+1	89+7	28+2	55+3	31+3	53+4
4.13+0.15	46+1	89+6	27+3	54+4	28+2	53+7
4.97+0.32	48+3	77+4	25+2	46+8	31+3	49+4
5.18+0.26	46+2	78+4	28+3	45+3	30+2	50+9
5.50+0.12	44+4	76+3	28+3	45+3	28+2	49+3
6.12+0.11	47+2	78+5	27+2	48+4	30+1	49+6
3.962+1.479	**47+2**	**92+20**	**27+2**	**54+7**	**29+2**	**57+8**
			***	***	***	***
			(42.55)	(41.94)	(38.30)	(38.04)

******* *Highly Significant (P<0.001); Values in paranthesis = Percent decrease in comparison to control.*

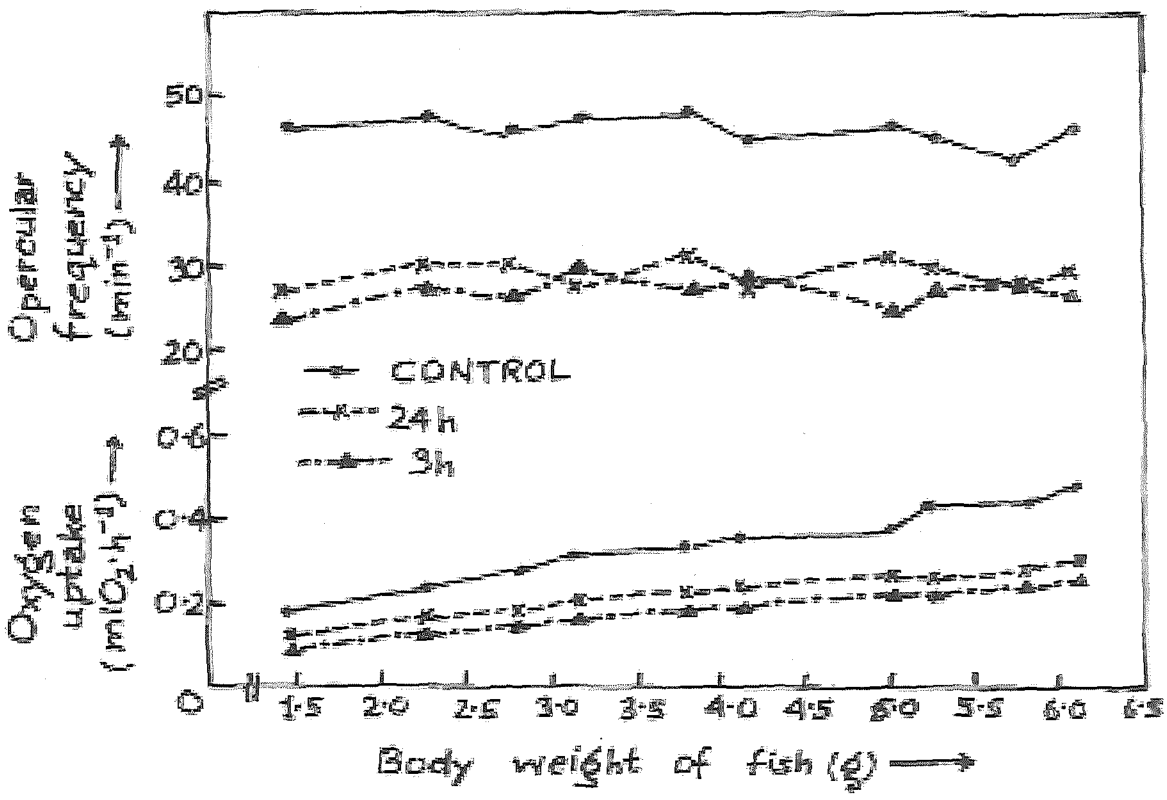

Fig. 1: Variation in opercular frequency and oxygen uptake of Channa punctatus *due to 3h and 24h anaesthetization with benzocaine.*

stimulus, decrease in propagation of impulse and increase in refractory period of neurons. All these changes are related with the reduction of metabolic rate. Further, it seems that anaesthetic affects brain either directly or through blood which influences the changes in behaviour of fish as well as reduces opercular movement and ultimetly oxygen consumption (Figure-1). The phenomena also corroborates the description of Goel and Sastri (1995).

Thus, the use of anaesthetic makes the experimental procedure easier, reduces the chances of physical damage, provides serene condition to the fish and reduces oxygen consumption. The information may be applied during live transportation of fish, packing of fish either for artificial breeding and other related purpose.

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