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Study of changes in bimodal oxygen uptake of obligate air breathing *Anabas testudineus* fish

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Abstract
In this study an Animal life on earth is dependent upon its ability to utilize oxygen and eliminate carbon dioxide. Respiration is one of the most important physiological parameters on which many of the vital functions like growth and reproduction of fish depend, which in turn, has a direct bearing on the productivity of freshwater ecosystems in terms of fish production per unit area.

Keywords: bimodal oxygen, obligate air, *Anabas testudineus* fish

Introduction
The freshwater air breathing fishes of tropical countries inhabit waters of low O2 contents and also experience hypoxic water in summer and normoxic water during winter and rainy season. In accordance with the fluctuations in the physico chemical characteristics of the ambient waters, the air breathing fishes are equipped with bimodal gas exchange machinery, employing two modes of respiration using highly vascularized air breathing organs to combat the adverse ecological conditions of their habitat.

One of the early symptoms of acute pesticide poisoning is the alteration or failure of respiratory metabolism (Holden, 1973). Changes in oxygen uptake of fishes in response to pesticide exposure are varying in different fishes exposed to a variety of pesticides (Karuppiah, 1996) [4]. The effect of pesticides on oxygen consumption has been extensively studied in a number of water breathing fishes (Mount, 1962; Waiwood and Johansen, 1974; Vasanthi, 1985) [5, 6, 7]. However the above investigators estimated only the changes in aquatic respiration even though the air breathing fishes like, *Mystus vittatus* (Gopalakrishna Reddy and Gomathy, 1977) [8] and Channa punctatus (Sambasiva Rao *et al.* 1984) [2] were used in their investigations. A perusal of literature indicates that the effects of pesticides on the proportion of oxygen uptake from water and air by air-breathing fishes were studied by only a few investigators (Bakthavathasalam, 1980, Natarajan, 1981; Ganapathyraman, 1987 and Karuppiah, 1996) [4], as such the present work has been taken into account in an obligate air breathing fish, *Anabas testudineus* (Bloch) to fill up the gap of our informations in this regard.

Material and Method
Anabas testudineus (Bloch) also known as climbing perch is an air breathing fish belonging to the family Anabantidae of the order perciformes. It is found in estuaries and freshwaters of India. It is voracious carnivore and is reported to leave the water in search of earthworm etc. It has a very good flavour and is popular as food. This fish has bimodal gas exchange mechanism as it extracts 02 from water through gills and from air by accessory respiratory organs. The accessory respiratory organs comprise one pair of simple labyrinthine organs enclosed in a pair of suprabranchial chambers.

Live specimens of *Anabas testudineus* were procured from local fish dealers at Saran and maintained in large glass aquaria with continuous flow of water. The fishes were fed on chopped goat liver daily during a minimum acclimation period of seven days in the laboratories. Routine oxygen consumption from air and still water was measured in a closed glass respirometer containing 3 litre of water (initial O2 content 6.5 mg O2/litre; pH 7.2) and one litre of air as show in figure.

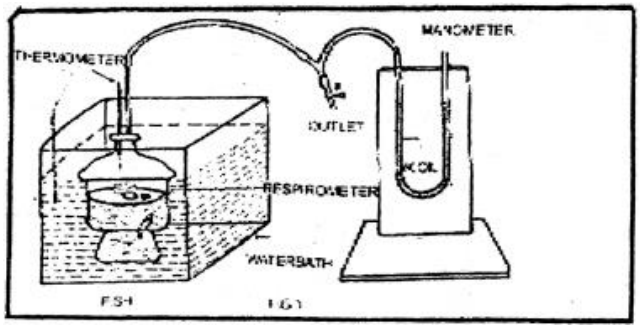

Fig: Experimental set up for the measurements of bimodal O2 uptake in *Anabas testudineus* (Bloch).

The fish had free access to air through a small semicircular hole (2" diameter)' in a disc float. Carbosorb (B.D.H) or KOH in a petridish placed on the float absorbed Co2, Thus the fish could exchange gases with water by way of its gills as well as with the air using the suprabranchial chamber. The air phase of respirometer was connected to a differential manometer. Movement of the manometer fluid follow uptake of oxygen when the Co2 is absorbed by "Carbosorb" (KOH) The fish were acclimatized to the respirometers at least 12 hours before the reading were taken. The concentration of dissolved O2 in the water was estimated by Winklers Volumetric method (Welch, 1948). The oxygen uptake through gills was calculated from the difference between the O2 levels of the ambient water in the respirometer before and after the experiment and the volume of water in the respirometer. Oxygen uptake from air was measured and calculated from recording the volume change in the manometer and by the use of the combined gas law equations and vapour pressure (Dejours, 1975). Means values of VO2 of a series of observations, on each fish at STPD and standard errors were calculated. The experiments were conduct at 29.0±1.50C. pH of the ambient water was measured by an electronic pH meter (systronics). The respiratory chambers were thermostated by immersion in a temperature controlled water bath.

Discussion

Different water bodies with varied physico-chemical characteristics are present in tropical India. Various piscine organizations, including gills are modified to suit these water bodies. The bimodal breathers can survive in hypoxic and hyper carbic swamy waters or even polluted wates due to the presence of air breathing organs, supplementary to gills. However, such water bodies are unsuitable for obligate water breathers for the lack of air-breathing organs.

There are mainly three groups of insecticides namely organochlorine. Organophosphate and carbamate which are used for selective killing of pests in a biological community. It is very interesting to note that all the different groups of pesticides or even the different pesticides of the same group do not have the same effect on fishes. The mode and site of action of different insecticide also differ and therefore, it is very difficult to generalize the effect of different pesticides in fishes unless a detailed investigation is carried out.

The results obtained in the present study on the bimodal oxygen uptake of control fish ndicates that the obligate air breathing fish, *Anabas testudineus* predominantly relies on aerial gas exchange obtaining 54% of its total oxygen uptake by their air breathing organ whereas only 46% was contributed by gills. Similar trends have been reported by Karuappiah (1996) [4] in Channa striatus and Munshi *et al.* (1979) in *C. marulius* (84.5%), *C. striatus* (67.7%), *C. gachua* (53 4%) and C. punctatus (86.8%) In the present study in *Anabas testudineus* the contribution of gas exchange through aerial route increased between 62 70% following exposure of different concentration of Metacid-50, Dithane M-45 and Keithane which, is consistent with the findings of Karuppiah (1996) [4] and Pandey *et al.* (1999) [1].

Conclusion

In the present study in *Anabas testudineus* significant decrease in both aquatic and total oxygen uptake was observed following exposure to different concentration of Metacid-50, Dithane-M-45 and Kelthane which is consistent with the findings of Pandey *et al.* (1999) [1]. Though the exact reason for the decrease in O2 uptake in this fish could not be understand but Chambers (1976) has stated that the mode of action of organophosphate insecticides is the irreversible inhibition of acetylcholinesterase, with death in vertebrates usually attributed to respiratory failure from paralysis of respiratory muscles. Similar explanations may be followed here the increased dependency on aerial respiration in *Anabas testudineus* following exposure to Metacid, Dithane and Keithane probably indicates that the fish tries to avoid the aquatic medium containing sublethal concentration of pesticides.

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