IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 9, Issue 2 Ver. III (Feb 2015), PP 07-09
www.iosrjournals.org

Thermal Adaptability and Behaviour Pattern of Fresh Water Air-Breathing Teleosts

N.Peetabas, B.B.Patra and R.P.Panda
Department of Botany, Science College, Kukudakhandi, Odisha
Department of Physics, Science College(Autonomous), Hinjilicut, Odisha and
Department of Zoology, Anchalik Science College, Kshetriyabarapur

Abstract: *Both young ones and adults of Anabas, Heteropneustes and Amphipnous could survive 72h of exposure to temperature of* 40^0*,* 36.5^0 *and* 36^0C *for acclimation tried, i.e.* 25^0*,* 30^0 *and* 35^0C *respectively. None of the fishes survived at* 15^0C *in low lethal testis. The thermal tolerance area was estimated to be* 700^0C^2*,* 501^0C^2 *and* 466^0C^2 *for young ones and adult of three species respectively.*

I. Introduction:

There are only a few studies on the temperature tolerance of Indian freshwater air-breathing teleosts, e.g. on juvenile specimens (18-23g) of **Channa punctatus** (Ananthakrishnan & Kutty, 1976); on both young and adult specimens of **Channa punctatus** and **Clarias botrachus** (Patra & Datta Munshi,1980). Therefore, it is of interest to study the temperature tolerance of young (immature) and adult (mature) air-breathing fishes of India.

II. Materials And Methods

Anabus testudineus (Bloch.) **Heteropneustes fossilis** (Ham.) and **Amphipnous Cuchia**(Ham.) are commonly available in the swamps of North Bihar. These were collected in the summer season (1980) and maintained in large glass aquaria (40l) at an ambient temperature of 30.0 ± 1^0C in the laboratory for two weeks. During this period they were fed on pieces of goat liver small prawns and crushed earthworms on alternate days(earth-worms were found to be best food for them)

Prior to experiment, the fishes were acclimated to 25^0, 30^0 and 35^0C for about two weeks. The freshwater in the test bath was well aerated to maintain oxygen level close to air-saturation. The fishes were starved for 24 h prior to tests. The method of lethal temperature study followed that described by Fry et al, (1946) and Brett(1952). In each set, six fishes of young and adult of same weight groups were exposed to the concerned lethal temperature by transferring them to water heated or cooled to the desired test temperature for a maximum period of 72h. The temperature at which the animal became visibly incapacitated was taken as a measure of its lethal temperature and the time was noted. The breathing behaviour of the fish at all acclimated and test temperatures, opercular frequencies, counted for a period of one minute at intervals of 30 minutes and the amplitude of their movements were recorded.

III. Results And Discussion

Time required for the death of 50% of the exposed fish was referred to as median resistance (survival) time. These durations {in minutes) of **Anabas** were 870,615 and 412 for young; 1030, 860 and 730 for adult at.15°C; 3410, 4260 and 4800 for young, 3200, 3400 and 3730 for adult at 42°C; 1830, 3660 and 3640 for young. 1600. 2000 and 2560 for adult at 43°C; 960, 2630 and 3030 for young, 810,1200 and 1800 for adult at 43.5°C acclimated at 25°, 30°'and 35°C, respectively (Table 1).

At similar acclimation of temperatures, the median resistance times in minutes for **Heteropneustes** were 2100,1630 and 1200 for young. 3000, 2280 and 1460 for adult at 15°C; 3220, 3680 and 4015 for young, 2600, 3355 and 3718 for adult at 38°C; 2850, 3157 and 3533 for young; 2235, 2650 and 3200 for adult at 39°C; 2310, 2637 and 3060 for young. 1440, 1818 and 2528 for adult at 40°C; and 1710, 1900 and 2310 for young. 531, 1531 and 2045 for adult at 41°C respectively (Table 1).

In case of **Amphipnous**, the median resistance times in minutes were 1630,1203 and 840 for young, 2210.1505 and 1020 for adult at 15°C; 1863, 2330 and 2660 for young, 1390,1960 and 2310 for adult at 37°C; 1060, 1680 and 2030 for young, 900, 1230 and 1820 for adult at 38°C. respectively (Table 1).

From the observed data, it was quite evident that none of the fishes whether young or adult could withstand the low temperature of 15°C (low lethal point). The high lethal points differ in different species such as 42°C for **Anabas**, 38°C for **Heteropneustes** and 37°C for **Amphipnous**. When the percentage survival was plotted against the test temperatures, 72h median tolerance limit was seen to have been in the vicinity of 44°C for young and adult of **Anabas**, 41°C for **Heteropneustes** and 38.5°C for **Amphipnous**.

The fish acclimated at 35°C and gradually exposed to high temperatures, lost the heat tolerance characteristics of the control group (acclimated at room temperature of 30°C). The 72h median heat tolerance limit of young and adult fish fell respectively from 2630 to 960 min,1200 to 810min. at 43.5°C for **Anabus**; 1900 to 1710 min. 1531 to 731 min. at 41°C for **Heteropneustes**; and 1680 to 1060 min. 1230 to 800 min. at 38°C for **Amphipnous**. However, when exposed to low lethal temperature of 15°C the fishes gained the cold tolerance characteristics of the control group. The 72h median resistance time increased (in minutes) from 615 to 870, 860 to 1030; 1630 to 2100. 2280 to 3000: and 1203 to 1630, 1505 to 2210 in young and adults of **Anabas**, **Heteropneustes** and **Amphipnous**, respectively. Further, 72h median heat tolerance limit of all 3 fishes acclimated at 35^0C, when compared with those of control groups gained the heat tolerance characteristics and lost the cold tolerance capacity (Table 1).

The amplitude of opercular frequencies per minute in relation of ambient and test temperatures in young and adult of **Anabas** and **Heteropneustes** even in the same weight groups at different temperatures varied from 60-67 and 31-36, 180-183 and 105-113, respectively. The rate of opercular frequencies increased with increasing temperature but at pre-lethal point it was suddenly decreased and continued till lethality.

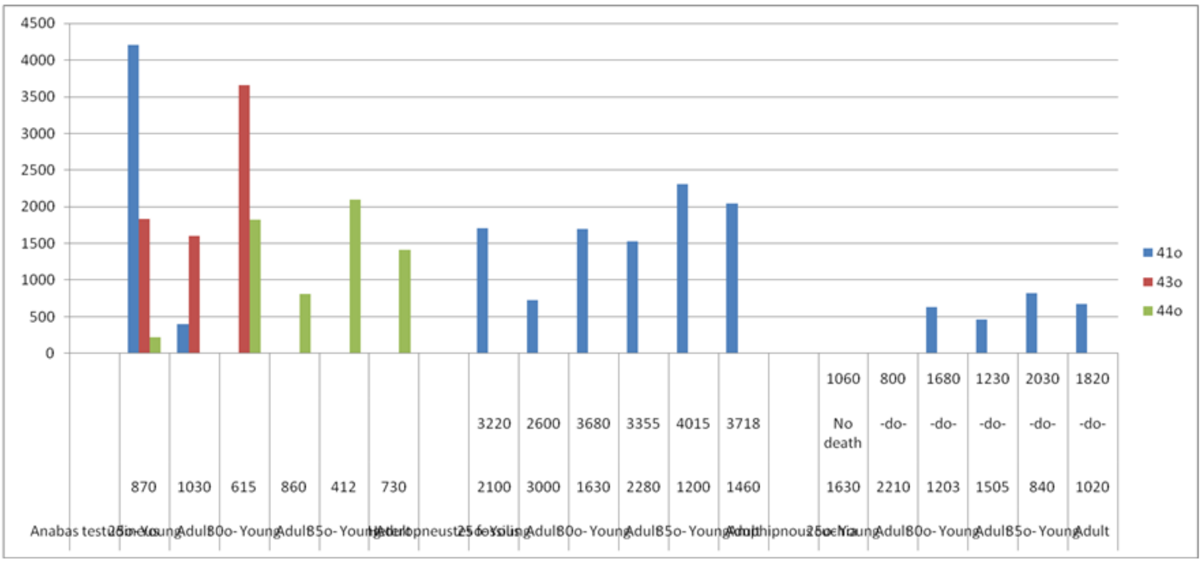
In both young and adult of these fishes, the time interval between two successive air-breath decreased with increasing temperature, showing that they depended more on air-breathing. They could withstand high temperature of 43°C (**Anabas**), 39.5^0C (**Heteropneustes**) and 37°C (**Amphipnous**) but with sudden drop of air-breaths. At 15°C the time interval of two successive air-breaths was very feeble and could not be recorded.

Further at 40°C for **Anabas**, 36.5°C for **Heteropneustes** and 36°C for **Amphipnous**, they became quite restless, remained parallel to water surface (**Anabas** & **Heteropneustes**) with rapid opercular movement and frequent aerial breathing; whereas, **Amphipnous** lay parallel at the bottom of the aquarium. Just before lethality they were soon displaced from surface to the bottom of the aquarium. lay silently with feeble opercular movement and without aerial breathing. Then the body colour was changed from normal to yellowish with excessive secretion of mucus.

An interesting behaviour of aerial mode of breathing was recorded in **Anabas** and **Heteropneustes** at room temperature. They rose to the surface to gulp in air in groups at a time when a small population of the fish was kept in an aquarium. One fish came up first to the surface, followed then by many fishes at a time.After additional feeding sometimes, almost all **Heteropneustes** took rest for a long time perpendicular to the aquarium in the midst of the water at one position quietly. It appeared like a hanging system and balanced mechanism to gravitational force. Sometime, (specifically at night) they altogether lie overlapping one another and at other times, stand vertically upwards just touching the tip of their tails at the bottom of the aquarium. **Anabas** also showed the same behaviour pattern. It remained parallel to the midst of the aquarium water quietly for a pretty long time. Another interesting observation was in their feeding activity. The fishes were normally fed at 10 a.m. on alternate days by the author. After being complete acclimatization to laboratory condition, the fishes showed punctuality in their daily feeding routine, since they all regularly approached in a row to the front side of the glass aquarium at 10a.m. They were also aware of the exact day of feeding. They were aware of the feeder, as they approached him with-out fear, and in case of stranger, they try to hide here and there in the aquarium.

Table-1. Median resistance times (LT50) in minutes of fishes acclimated to 25^0, 30^0 and 35^0C in tested at various lethal temperatures.

Tem.(°C)	15°	36°	38°	38.5°	41°	43°	44°
Anabas testudineus							
25°- Young	870				4210	1830	220
Adult	1030				400	1600	
30°- Young	615				No death	3660	1820
Adult	860				-do-	2000	815
35°- Young	412				-do-	3640	2100
Adult	730				-do-	2560	1410
Heteropneustes fossilis							
25°- Young	2100		3220		1710		
Adult	3000		2600		731		
30°- Young	1630		3680		1700		
Adult	2280		3355		1531		
35°- Young	1200		4015		2310		
Adult	1460		3718		2045		
Amphipnous cuchia							
25°- Young	1630		No death	1060			
Adult	2210		-do-	800			
30°- Young	1203		-do-	1680	630		
Adult	1505		-do-	1230	460		
35°- Young	840		-do-	2030	820		
Adult	1020		-do-	1820	670		



Studies on temperature tolerance reveal their individual characteristics. Animals acclimated at high temperature (35°C) are relatively heat resistant and cold sensitive, whereas animals acclimated at low temperature (25°C) are relatively cold resistant and heat sensitive. The size of the fish and order of death occurrence were examined to determine whether size has any critical effect on high or low temperature tolerance. At high temperature, the older fishes died earlier than the younger ones. The younger ones seem to remain physiologically active as the time taken to reach the lethal incipient point is longer. The older fish, though more sensitive at high temperature, are physiologically slightly more tolerant to low temperature. This is in conformity with the views of Fry et al(1946), Ananthakrishnan &_Srinivasan (1977 Patra & Daua Munshi (1980), Pal etal (2008), Tripathy and Harsh (2002). The reverse cases are observed at lower incipient lethal temperature (15°C). The younger fishes died earlier than older ones.

The total area bounded by the trapezium which denotes the thermal tolerance zone can be expressed in °C^2 units (Fry, 1948)_and this can be expected to show quantitatively the thermal tolerance of the species concerned. As such this is estimated to be 700°C^2, 501 °C^2 and 466°C^2 for both young and adult specimens, in comparison with 1220°C^2. 420°C^2. 410°C^2, 700^0C^2. 510°C^2 units for gold fish sockeye salmon **Channa punctatus** (young only), **C.punctatus** and **Clarias batrachus**, respectively. It may be concluded that the tropical **Anabas**, **Heteropneustes, Amphipnous, Channa** and the high temperate sockeye salmon are 'Stenothermal' whereas the low temperate gold fish is 'Eurythermal'.

A very interesting pattern of breathing behaviour observed in **Anabas** and **Heteropneustes** rising to the surface to take in air by more than one fish at a time throws light over their social mode of life. Perhaps they live together in many numbers in one ecohabitat and maintain a society like other vertebrates. However, a detailed study of the social behaviouristic pattern of these fishes in relation to breathing habit would offer an interesting field of research.

References

[1]. Ananthakrishnan, K.R. and Kulty, M.N Temperature tolerance of the air-breathing fish. **Ophiocephalus punctatus**. **Comp. Physiol. Ecol** ,1976, 1,18-22.
[2]. Srinivasan, K. Effect of dilutions of sea water on the upper lethal temperature of the cihlid fish, **Tilapia mossambica** (Peters). **Ibid.,** 1977, 2,154-159.
[3]. Brett, J.R, Temperature tolerance of young pacific salmon genus, **Oncohynchus. J. Fish, Res**. **Bd. Can**., 1952, 9, 265-307.
[4]. Fry, F.E.J. Effects of environment on animal activity. **Univ. Toronto Studies**, **Biol. Ser.** 55; Publ. **Ontario Fisheries Res. Lab,** 1948,68,5-62.
[5]. Hart, H.S. and Walker, J.S. Lethal temperature relations for a sample of young specked trout. **Salvelinus fontinalis. Ibid,** 1946.54.1-47.
[6]. Pal A. Parida, SP Swain MM(2008) Haematological and plasma biochemistry in fan throated lizard sitana panticeriana (Sauria Aganidae), Rus. J. Herp 15(2); 110-116.
[7]. Patra, A.K. and Datta Munshi, J.S. Studies on the temperature tolerance of two freshwater air-breathing teleosts, **Channa punctatus** (Bloch.) and **Clorias batrachus** (Linn.). **Proc. Symp. Environ. Trivandrum** 1980. pp. 125-138.
[8]. Tripathi G. Harsh S (2002) Fenvelerate-induced macromolecular changes in the Cat fish, Clarias battrachus , J. Environ, Biol, 23; 143-146.