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Hypoxic Tolerance of the Young ones of Sea Bass, *Lates calcarifer* (Bloch)

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Maximum tolerance to hypoxia until asphyxiation (loss of equilibrium) in the case of young ones of sea bass, *Lates calcarifer* was found in sea water, brackish water and freshwater at 30°C and 35°C. The hypoxic tolerance observed was comparatively high in sea water, followed by brackish water and freshwater at both 30°C and 35°C. The tolerance limit observed was more in sea water, possibly due to less osmoregulation in the natural habitat or due to the metabolic homeostasis.

Key words: *Lates calcarifer*, **tolerance, hypoxia**

The rate of metabolism is directly or indirectly influenced by biotic and abiotic factors and among them ambient oxygen and temperature exert the greatest influence. The active metabolic rate of fish is far more sensitive to the availability of environmental oxygen. The anaerobic abilities of many fishes are not known, because most of them are not subjected to proper experimentation. When the supply of oxygen is not sufficient to meet the minimal energy demands of essential funtions, fishes suffocate in natural conditions when their well oxygenated water body is confronted with oxygen deficient water. In such condition, some fish seem to become more passive and some more active, thereby establishing a dichotomy in behaviour (Peer Mohamed and Kutty, 1982). Thus the increase in ambient oxygen from air saturation down to the asphyxial oxygen level can cause different behavioural responses which have a major role in the survival of the species. Very few attempts have been made on tropical fishes, especially the influence of ambient oxygen on their random activity (Hamsa & Kutty, 1972; Peer Mohamed, 1981; Peer Mohamed & Kutty, 1980 and 1981; Rausch, 2000) despite the fact that in nature they are often subjected to hypoxic (low ambient oxygen) and anoxic (lack of oxygen) conditions at high temperatures. Since the information available on *L. calcarifer* is inadequate, there is a need for documentation of such information on this tropical eurythermal species, which is likely to be exposed to the conditions of very low oxygen and high temperatures in view of its ecophysiological characteristics.

Materials and Methods

Totally ninety nos. of *L. calcarifer* (a minimum of fifteen fish in each medium

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and each temperature) were acclimated to sea water, brackish water and fresh water at 30°C and 35°C for 7-10 d before experimentation. Details of fish used are given in Table1. The fish were starved for 24 h in order to maintain the physiological conditions of the fish almost uniform and also to avoid contamination of the respirometer. The respirometer (a modification of Fry's respirometer), the experimental set-up and experimental procedure followed were similar in all three media at 30°C and 35°C After introducing the experimental fish into the respirometer containing the air saturated medium, the dissolved oxygen was reduced by the respiration of the fish itself until the fish lost its equilibrium. Dissolved oxygen was estimated by the modified Winkler technique (Strickland & Parsons, 1968).

Results and Discussion

In sea water, the mean asphyxial oxygen was found to be 1.17 ml/l at 30°C and 1.45 ml/1 at 35°C. The high and low asphyxial oxygen concentration observed were 2.5 ml/l (Fish weight : 42.00g) and 0.5 ml/l (Fish weight : 19.59g) at 30°C and 2.4 ml/l (Fish weight : 20.12g) and 0.9 ml/l (Fish weight :37.61g) at 35°C.

When salinity was decreased to 15% S (brackish water) the mean asphyxial oxygen was found to increase from 1.53 ml/l at 30°C and 1.60 ml/l at 35°C. The highest and lowest levels of asphyxial oxygen during asphyxia were 2.6 ml/l (Fish weight : 34.90g) and 0.7 ml/l (Fish weight : 38.10 g) at 30°C and 3.0 ml/l (Fish weight : 40.88g) and 0.8 ml/l (Fish weight : 13.17g) at 35°C.

When the salinity was further decreased to 0 ‰ S (freshwater), a value of 1.54 ml/l at 30°C and 1.60 ml/l at 35°C were observed as the mean values of asphyxial oxygen concentrations. The maximum and minimum levels detected were 3.1 ml/1 (Fish weight : 25.66g) and 0.5 ml/1 (Fish weight : 23.81 g) at 30°C. The corresponding levels at 35°C were 2.5 ml/1 (Fish weight : 61.04) and 0.6 ml/1 (Fish weight : 59.10g).

Comparatively, the hypoxic tolerance observed was more in sea water at 30°C. According to the asphyxial oxygen levels obtained, the order of hypoxic tolerance which is the same as that of the anaerobic abilities (Peer Mohamed and Kutty, 1982) in different media can be arranged as follows : sea water > brakish water > freshwater at 30°C and 35°C (Table: 2). When the

Table 1. Details of fish used for the experiments

Medium	30°C No of fish used	30°C Length in cm	30°C Weight in g.	35°C No of fish used	35°C Length in cm	35°C Weight in g.
Sea Water	15	10.72 ± 1.18	21.70 ± 11.68	15	11.99 ± 0.13	28.99 ± 4.45
Brackishwater	15	13.6 ± 1.0	33.97 ± 5.56	15	12.82 ± 2.09	30.17 ± 11.58
Freshwater	15	13.19 ± 0.88	32.64 ± 5.60	15	13.12 ± 1.33	36.49 ± 9.43

Table 2. Asphyxial oxygen concentration (ml/l) of *Lates calcarifer* in seawater, brackishwater and freshwater at 30 and 35°C.

	Seawater		Brackishwater		Freshwater	
	30°C	35°C	30°C	35°C	30°C	35°C
High asphyxial oxygen concentration	2.5	2.4	2.6	3.0	3.1	2.5
Mean asphyxial oxygen concentration	1.17	1.45	1.53	1.60	1.54	1.60
Low asphyxial oxygen concentration	0.5	0.9	0.7	0.8	0.5	0.6

temperature was increased to 35°C, it was observed that the tolerance limit was significantly lower in sea water, brackish water and freshwater. However, at both the temperatures the order of tolerance was similar. It is evident from Table 2 that the tolerance was higher at 30°C than at 35°C in all the media.

During hypoxia, decrease in ambient oxygen from air saturation down to asphyxial level of oxygen concentration can cause different behavioural responses. The difference in behaviour pattern during hypoxic exposure may have a special significance for survival (Peer Mohamed and Kutty, 1980). Gold fish withstands low oxygen concentrations well (Prosser *et al* 1957; Kutty, 1968) but rainbow trout is relatively intolerant to low oxygen concentrations (Parry and Holiday, 1960; Kutty, 1968).

In *L. calarifer*, as in the case of *Chanos chanos* and *Mugil cephalus* (Usha Devi, 1987), complete anoxic tolerance cannot be claimed since the experiments were conducted in a closed system. The minimum rate of asphyxial oxygen observed in this species was 1.17/ml/1 which was in sea water at 30°C and hence below this rate it cannot survive. In sea water, which is the natural habitat of the sea bass, capacity of tolerance is more compared to other media, perhaps due to lower osmoregulation, suggesting the operation of a metabolic homeostasis alongside regulation as pointed out by the earlier workers in this area (Bshamohideen *et al*, 1972).

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