Behaviour of fourteen exotic ornamental fishes of Bangladesh under starved condition in aquaria

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Abstract

The behaviour of fourteen exotic ornamental fishes of Bangladesh under starved condition in aquaria was experimented from January to December, 2011. Fishes were belonging to 13 genera, 09 families and 4 orders. Two treatments each with three replications were used. Four different behavioural phases of fish were monitored through constant observation. Almost all the behavioural phases were seen earlier in the fishes of treatment T_1. Marble angel survived more (1022±4.02 hrs; T_2) than others. The lowest survival period (116±2.44 hrs; T_1) was seen for albino suckermouth. Fishes were died earlier in T_1 than T_2, due to presence or absence of aeration facilities. Water temperature, dissolved oxygen, free CO_2, pH, total alkalinity, ammonia-nitrogen and chlorine level were found to be varied from 25.66±0.17 to 28.66±0.35°C, 3.80±0.06 to 4.73±0.07 mg/l, 9.21±0.05 to 11.75±0.03 mg/l, 7.13±0.05 to 7.47±0.07, 76.66±1.64 to 108.92±3.20 mg/l, 0.0010±0.0006 to 0.0133±0.002 mg/l and 0.0045±0.001 to 0.012±0.0014 mg/l, respectively. The research findings would be helpful in gathering basic knowledge on different behavioural phases through which aquarists can maintain primitive behavioural phase in their aquaria. Further research work is suggested in the aforesaid theme massively.

Keywords: Behaviour, water quality, ornamental fish, starved condition, aquaria

INTRODUCTION

Changes in behavioural phases respond quickly to changes that arise in animals surrounding and may be used as early warning signals about the impaired environmental quality. A lot of external factors such as contaminants, restricted food resources, fluctuating temperature, etc. influence the fish organism and behaviour as well (Atchison *et al.* 1987). Thus, changes in external environmental conditions may evoke various behavioural responses in fishes. Starvation is usually the result of poor husbandry and, in many cases, is a squeal to environmental problems. A poorly designed or maintained system is likely to develop water quality problems with different behavioural phases among the fish (Namrata *et al.* 2011). Animals deprived of food are more likely to travel further and invest more time in search of food than satiated con-specifics (Torres *et al.* 2002), thereby utilizing energy that might otherwise have been allocated to purpose such as growth or reproduction. Additionally, starved animals may exhibit reduced anti-predatory behaviour later to gain increased access to a food source (Vadas *et al.* 1994). Specific behavioural displays in response to starvation can be highly variable, as environmental conditions (e.g. predators, refuge) (Wojdak 2009) or physiological traits, such as fat storage (Jacome *et al.* 1995), might modulate responses. Altogether, starvation generally modifies the actions related to food acquisition which in turn may have consequences for an organism's survival and behavioural interactions (Vadas *et al.* 1994). In salmonids, deprivation of food causes an increase of aggressiveness by increasing the number of aggressive encounters (Johnson *et al.* 1998). It is known that, hunger increases the

concentration of the growth hormone in fish organism. The growth hormone increases metabolic demands, feeding motivation, competitive ability and aggression in fish (Petrauskiene 2002). During the time of starvation, aquaria's fishes make frequent travel vertically and horizontally inside the aquaria often increase their metabolic rate and oxygen uptake. In the process of oxygen uptake, fish always expend energy usually on ventilation and often on locomotion (Kramer 1987). These costs will vary with oxygen availability and thus different types of behavioral responses shown. The principal categories of behavioral response to reduced external availability of food and oxygen are (1) changes in activity, (2) increased use of air breathing, (3) increased use of aquatic surface respiration, and (4) vertical or horizontal habitat changes. Several authors have already been published their books and research works about behavioural phases of different tropical fishes in response to stress, toxicants, heavy metals, etc. but there was some lacking too on such information regarding behavioural phase of exotic ornamental fishes of Bangladesh under starved condition in aquaria. Thus the present study was performed for describing the different bahavioural phases of exotic ornamental fishes of Bangladesh under starved condition in aquaria with special reference to water quality parameters.

METHODOLOGY

Duration and location of the study: The entire research work was conducted for a period of twelve months (January 2011 to December 2011) to observe the different bahavioural phases of exotic ornamental fishes of Bangladesh under starved condition in aquaria in the Fisheries Laboratory at the Department of Fisheries, University of Rajshahi, Rajshahi, Bangladesh.

Experimental design: The present research was set up under two treatments (T_1 and T_2), each with three replications. In each experimental treatment, fish was released at the number of three for each species under starved condition. Treatment assignment was as follows:

T_1: Aquaria with no aerator facilities
T_2: Aquaria with aerator facilities

The major source of water for experimental aquaria was tap water. Aquaria size (90x35x35 cm) and volume of water (approximately 65 litres) was kept same for all treatments and experiments.

Commencement of study: Experimental exotic ornamental fishes were collected from local aquaria shop keepers of Rajshahi, Bangladesh. Fishes were in similar size and age groups. Then fishes were acclimatized in laboratory condition for a certain period and conditioned

for a week. During conditioning of fish, packed feed feeding was also performed twice a day. After seven days, conditioned experimental exotic ornamental fishes were released into the experimental aquaria and then the experiment was begun. After that, different bahavioural phases were monitored and water quality parameters were measured under starved condition in aquaria during the study period.

Topics related to study

Different bahavioural phases of experimented fish species: Behaviour of the experimental exotic ornamental fishes was monitored by careful observation to understand their various behavioural phases in terms of starved condition in aquaria during each experiment. The behaviour of fishes was categorized into four phases in order to make argument easier. These are: primitive phase*,* behaviour after releasing fish up to show abnormal behaves; acute phase, behaviours include aggression, abnormal movement and swimming; moribund phase, behaviours include unbalancing, lethargic condition etc.; and death phase, time duration from releasing of fish up to death.

During this experiment, fishes were sacrificed to death. Monitoring of behaviour was done through eye observation.

Water quality parameters: Physico-chemical parameters *viz.,* water temperature, hydrogen ion concentration (pH), dissolved oxygen (DO), free carbon dioxide (CO_2), ammonia-nitrogen (NH_3-N_2), total alkalinity and chlorine were measured twice a week between 09.00 and 11.00 AM on each sampling day to develop idea about the condition of water quality of aquaria during each experiment. pH, DO, free CO_2, NH_3-N_2, alkalinity and chlorine were measured by using HACH kit (FF-2).

Data analysis: Data related on total survival days and water quality under different experimental treatments was subjected to computer software Microsoft Excel to analyze mean and standard error (±SE).

RESULTS AND DISCUSSIONS

Behavioural phases: In the present study, behavioural phase of exotic ornamental fishes was categorized into four phases based on their physical movement and aggressiveness which were changed after certain time interval under starved condition in aquaria. The findings for different experiments of exotic ornamental fishes described here through following four phases. Citation is still lacking as this type of work has not been conducted yet by other researchers. Details on the behavioural phase are shown in table 1.

Table 1: List of experimented fishes with different behavioural phases and their duration

Fishes	Different behavioural phases and their duration (ended up to hrs)					
	Primitive		Acute		Moribund	
	T_1	T_2	T_1	T_2	T_1	T_2
Fantail goldfish *Carassius auratus*	122± 2.73	168± 2.55	168± 2.36	216± 3.87	236± 4.31	290± 4.63
Rainbow shark *Epalzeorhynchus frenatus*	166± 3.24	242± 3.11	264± 2.61	336± 3.96	356± 3.21	398± 3.94
Tiger Barb *Barbus tetrazona*	98± 2.41	146± 2.35	168± 3.88	216± 4.12	202± 2.88	256± 3.45
Zebra fish *Danio rerio*	145± 2.62	166± 1.79	168± 2.26	216± 3.76	242± 2.88	306± 3.46
Horseface Loach *Acantopsis choirorhynchos*	45± 1.30	68± 1.45	120± 1.29	144± 1.09	216± 2.30	282± 2.55
Marble Angel *Pterophyllum scalare*	483± 3.95	653± 4.88	696± 4.36	840± 3.98	836± 4.32	1022± 4.02
Golden Gourami *Trichogaster trichopterus*	293± 3.56	339± 4.25	480± 4.34	552± 4.10	596± 4.21	664± 4.55
Guppy *Poecilia reticulata*	73± 1.54	92± 1.32	96± 2.33	144± 2.10	136± 2.22	242± 2.01
Black Molly *Poecilia sphenops*	95± 1.88	162± 2.64	192± 2.55	240± 2.31	342± 3.84	402± 3.29
Swordtail *Xiphophorus helleri*	142± 2.65	190± 2.85	192± 2.62	240± 2.43	332± 3.93	396± 3.41
Tiger Shark *Pangasius hypophthalmus*	263± 4.62	338± 4.33	384± 3.44	432± 2.63	472± 3.97	524± 4.32
Albino suckermouth *Hypostomus plecostomus*	43± 2.33	76± 2.54	72± 1.73	96± 3.96	116± 2.44	160± 3.87
Clown catfish *Synodontis decorus*	93± 1.16	141± 1.25	168± 2.44	216± 3.47	294± 2.98	376± 3.78
Black skirt widow tetra *Gymnocorymbus ternetzi*	191± 1.56	263± 2.22	288± 3.51	360± 3.44	382± 4.65	444± 4.88

Primitive phase: In this phase, different fish species showed different behaviours. Goldfish were gregarious and swam in grouped; rainbow shark swam back and forth, more than up and down; guppy, swordtail, widow tetra and tiger barbs were showed very active and attributed nipping behaviour of its tank mates and constantly pestered the other fish in the tank but did not harm at all; black molly and zebra fish were social, swam in grouped and spent most of the time at the surface as they are surface dwelling fish; horseface loaches were usually hide during the day but are lively and active in the evening; marble angels were well behaved and post himself at the top of the tank most of the time but occasionally they were harassed one another- but nothing serious; golden gourami swam slowly mostly in the middle to top regions of the aquarium but was also explored in the bottom region not bothered any of the other inhabitants; tiger sharks were constantly on the move and occasionally went to the surface for air; albino suckermouth catfish spent most of the time at the tank bottom and the sides of the glass and very sensitive to their environment; clown catfish often forms good sized group and in the day time they were became shy and hardly be seen when exposure to bright light.

The duration of this behavioural phase was found lower (43±2.33 hrs; T_1) for the albino suckermouth and higher (653±4.88 hrs; T_2) for the marble angel. These behaviours were seen earlier in the treatment T_1 than the treatment T_2. This might be due to the comparatively suitable water quality (especially DO and free CO_2) in the treatment T_2 because of using aerator of that treatment and this was strongly supported by Kramer (1987).

Acute phase: In this phase, most of the experimented fish species (*viz.* rainbow shark, zebra fish, angel fish, gourami, guppy and black molly) showed aggressiveness, moving fast and driving force to other and sometimes caused harms to other (damaged and injured the fins and tails of other). Goldfish and angel fish were observed at the surface floating or gasping either for beg food or little oxygen in the water with the inclination of body axis with surface 30 to 35 degrees. Almost similar assumption was also made by William and Lewis (1970). Tigerbarbs and black skirt widow tetra were hanged out in a top corner of the aquarium and then swam erratically, floated upside down. Horseface loach spent most of their time in plain glass wall of aquarium by hanging out vertically. Golden gourami flared their fins and nipped and chased at another fish or slow moving ones. Swordtail increased their swimming activity through rapid caudal peduncle and axial body movement and spent more time searching for food than in normal circumstances. This accelerated intra-specific behavior increased aggressiveness and competition with other fish and most attack occurred at the bottom water. This was strongly supported by Johnson *et al.* (1998). During this phase, tiger sharks tend to swam very fast for finding food and they injured themselves due to their mindless flight through rushing around the aquarium. In this phase, they frequently smashed into the sides of the aquarium or other fish. Albino suckermouth catfish were observed at the corner of the aquarium sucking the protective slime coat of others or being slept. Clown catfish were non-aggressive and they got along well with other fish of same species constantly touching the other fish with their barbels. The duration of this behavioural phase was found lower (72±1.73 hrs; T_1) for the albino suckermouth and higher (840±3.98 hrs; T_2) for the marble angel. These behaviours were seen earlier in the treatment T_1 than the treatment T_2. This might be due to the comparatively suitable water quality (especially DO and free CO_2) in the treatment T_2 because of using aerator of that treatment. This statement was strongly supported by Kramer (1987).

Moribund phase: During this phase, most of the experimented fish species became less active and felt

restlessness due to their sickness and sank to the bottom of the aquarium and lie on its side or back. The duration of this behavioural phase was found lower (116±2.44 hrs; T_1) for the albino suckermouth and higher (1022±4.02 hrs; T_2) for the marble angel. These behaviours were also seen earlier in the treatment T_1 than the treatment T_2.

Death phase: During this phase almost all the experimented fish species became senseless at first and then floated in the water and died respectively for getting no food during the whole period of the experiment. At this phase, the colour of the fish body became dull and body size became shrank. After the study, it was found that, marble angel survived more (1022±4.02 hrs; T_2) than the other species used for the experiment in the given condition. Comparatively lower survival (116±2.44 hrs; T_1) was seen for the albino suckermouth. It was also seen that, fishes were died earlier in the treatment T_1 than fishes of treatment T_2. This might be due to the comparatively suitable water quality (especially DO and free CO_2) in the treatment T_2 because of using aerator of that treatment. This statement was strongly supported by Kramer (1987).

Water quality parameters: During the study period water chemistry (water quality parameters) under different treatments remained favorable for all experimented fish species. Details are given in Table 2. In the present study, water temperature found to be ranged from 25.66±0.17°C (for *B. tetrazona*) to 28.66±0.35°C (for *C. auratus*). Olufeagba *et al.* (1999) found the water temperature in his study ranges from 26-31°C for ponds and 26-30°C for aquaria tanks. Water depth remained same throughout the experiment (20.00±0.00 cm). The range of water depth (12-18 cm) reported by William and Lewis (1970) was also closer to the value of water depth found in the present study. Dissolved oxygen and free carbon di-oxide were found to be ranged from 3.80±0.06 mg/l (for *B. tetrazona*) to 4.73±0.07 mg/l (for *T. trichopterus*) and 9.21±0.05 mg/l (for *P. sphenops*) to 11.75±0.03 mg/l (for *P. scalare*) respectively. Comparatively higher dissolved oxygen and lower free CO_2 content were found in the treatment T_2 than the treatment T_1 in case of all experimental treatments.

Olufeagba *et al.* (1999) found the dissolved oxygen in his study ranges from 4.5-4.8 mg/l for aquaria tanks which was more or less similar to the value of dissolved oxygen found in the present study. Mitranescu *et al.* (2010) found CO_2 level ranges from 9-13 mg/l in studying water quality in experimental aquaria tanks with 80 % survival rate which was much closer to the value of the present study. pH varied from 7.13±0.05 (for *X. helleri*) to 7.47±0.07 (for *P. scalare*).

Baensch and Riehl (1997) recorded pH in their study ranges between 6.5-8.5 mg/l which much closer to the result of the present study. Almost similar finding was found by Mitranescu *et al.* (2010). Total alkalinity was found to be ranged from 76.66±1.64 mg/l (for *B. tetrazona*) to 108.92±3.20 mg/l (for *P. scalare*) which was strongly supported by the assumption of Ghosh *et al.* (2003). Ammonia-nitrogen and chlorine level were found to be ranged from 0.0010±0.0006 mg/l (for *H. plecostomus*) to 0.0133±0.002 mg/l (for *P. scalare*) and 0.0045±0.001 mg/l (for *B. tetrazona*) to 0.012±0.0014 mg/l (for *C. auratus* and *X. helleri*) respectively. Mitranescu *et al.,* (2010) found ammonia-nitrogen and optimal chlorine level ranges from 0.011 to 0.5 mg/l and 0.003 to 0.2 mg/l in studying water quality in three experimental aquaria tanks which was much closer to the value of the present study. It was found that water quality parameters remained well for experimented fish species in all of the experimental treatments but comparatively better in treatment T_2 than the treatment T_1.

Table 1: Recorded different parameters of water quality

Fishes		Temperature (°C)	DO (mg/l)	Free CO_2 (mg/l)	pH	Total alkalinity (mg/l)	NH_3-N_2 (mg/l)	Cl (mg/l)
Carassius auratus	T_1	28.66	4.34	11.61	7.21	96.21	0.0054	0.012
	T_2	28.54	4.63	11.17	7.22	97.23	0.0034	0.01
Epalzeorhynchus frenatus	T_1	26.81	4.23	9.58	7.23	97.06	0.0037	0.01
	T_2	26.79	4.67	9.25	7.23	97.95	0.002	0.008
Barbus tetrazona	T_1	25.66	3.8	10.38	7.25	76.66	0.0023	0.006
	T_2	25.66	3.98	10.11	7.25	76.93	0.0015	0.0045
Danio rerio	T_1	26.33	4.16	9.43	7.13	79.53	0.0023	0.0045
	T_2	26.33	4.32	9.26	7.13	79.84	0.0014	0.005
Acantopsis choirorhynchos	T_1	26.21	4.31	9.74	7.2	85.84	0.0028	0.008
	T_2	26.17	4.57	9.49	7.2	86.97	0.0013	0.006
Pterophyllum scalare	T_1	28.5	4.2	11.75	7.46	105.46	0.0133	0.008
	T_2	28.43	4.65	11.03	7.47	108.92	0.0085	0.006
Trichogaster trichopterus	T_1	27.18	4.11	9.8	7.46	91.01	0.0056	0.01
	T_2	27.17	4.73	9.21	7.46	92.08	0.0031	0.008
Poecilia reticulata	T_1	26.45	4.38	9.59	7.13	92.55	0.0028	0.011
	T_2	26.39	4.58	9.24	7.13	93.6	0.0015	0.01
Poecilia sphenops	T_1	26.64	4.3	9.57	7.14	94.59	0.0045	0.011
	T_2	26.56	4.7	9.21	7.14	94.95	0.0025	0.009
Xiphophorus helleri	T_1	26.94	4.23	9.73	7.13	83.66	0.0052	0.012
	T_2	26.88	4.43	9.54	7.13	83.99	0.003	0.01
Pangasius hypophthalmus	T_1	27.06	4.17	9.76	7.38	92.28	0.005	0.01
	T_2	27.05	4.65	9.27	7.38	93.2	0.0027	0.008
Hypostomus plecostomus	T_1	26.67	4.12	10.12	7.17	75.33	0.0017	0.011
	T_2	26.67	4.23	9.93	7.17	75.55	0.001	0.009
Hypostomus plecostomus	T_1	26.2	4.07	9.79	7.21	84.63	0.0032	0.01
	T_2	26.18	4.23	9.61	7.21	85.08	0.0016	0.008
Gymnocorymbus ternetzi	T_1	26.05	3.85	9.83	7.25	77.92	0.0035	0.007
	T_2	26.03	4.2	9.43	7.25	79.25	0.0023	0.006

CONCLUSION

Knowledge on different behavioural phase of ornamental fish species in aquaria is an essential pre-requisite for better husbandry and management practice. The study

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again proved that aeration system can make more or less better environment for fish than that of the without aeration one. The research findings will be helpful in gathering basic knowledge on different behavioural phases through which aquarists can maintain primitive behavioural phase all the time of the kept fish species in their aquaria. Further research work is needed in the aforesaid theme massively.

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