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 T1. Marble angel survived more (1022±4.02 hrs; T2) than others. The lowest survival period (116±2.44 hrs; T1) was seen for albino suckermouth. Fishes were died earlier in T1 than T2, due to presence or absence of aeration facilities. Water temperature, dissolved oxygen, free CO2, 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±0.0006 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 sequel 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
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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 behavioural 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 two treatments. In each experimental treatment, fish was kept same for all 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 behavioural phases were monitored and water quality parameters were measured under starved condition in aquaria during the study period.

Topics related to study

Different behavioural 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 ($\text{pH}$), dissolved oxygen ($\text{DO}$), free carbon dioxide ($\text{CO}_2$), ammonia-nitrogen ($\text{NH}_3$-$\text{N}$), 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. $\text{pH}$, $\text{DO}$, free $\text{CO}_2$, $\text{NH}_3$-$\text{N}$, alkalinity and chlorine were measured by using HACH kit (FF-2).

Data analysis: Data related to total survival days and water quality under different experimental treatments was subjected to computer software Microsoft Excel to analyze mean and standard error ($\pm$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 (ended up to hrs) | Acute (ended up to hrs) | Moribund (ended up to hrs) |
|                   | T₁₇ | T₂₇ | T₁₂ | T₂₁ | T₁₂ | T₂₁ |
| Fantail goldfish  | 122± | 168± | 168± | 216± | 236± | 290± |
| Carassius auratus | 2.73 | 2.55 | 2.36 | 3.87 | 4.31 | 4.63 |
| Rainbow shark     | 166± | 242± | 264± | 336± | 356± | 398± |
| Tiger Barb        | 98±  | 146± | 168± | 216± | 202± | 256± |
| Barbus traazona   | 2.41 | 2.35 | 3.88 | 4.12 | 2.88 | 3.45 |
| Zebra fish        | 145± | 166± | 168± | 216± | 242± | 306± |
| Danio rerio       | 2.62 | 1.79 | 2.26 | 3.76 | 2.88 | 3.46 |
| Horseface Loach   | 45±  | 68±  | 120± | 144± | 216± | 282± |
| Acantopsis choiri | 1.30 | 1.45 | 1.29 | 1.09 | 2.30 | 2.55 |
| Marble Angel      | 483± | 653± | 696± | 840± | 836± | 1022±|
| Pterophyllum scalare | 3.95 | 4.88 | 4.36 | 3.98 | 4.32 | 4.02 |
| Golden Gourami    | 293± | 339± | 480± | 552± | 596± | 664± |
| Trichagaster trichopterus | 3.56 | 4.25 | 4.34 | 4.10 | 4.21 | 4.55 |
| Guppy             | 73±  | 92±  | 96±  | 144± | 136± | 242± |
| Poecilia reticulata | 1.54 | 1.50 | 2.33 | 2.10 | 2.22 | 2.01 |
| Black Molly       | 95±  | 162± | 192± | 240± | 342± | 402± |
| Poecilia sphenops | 1.88 | 2.64 | 2.55 | 2.31 | 3.84 | 3.29 |
| Swordtail         | 142± | 190± | 192± | 240± | 332± | 396± |
| Xiphophorus helleri | 2.65 | 2.85 | 2.33 | 2.10 | 3.93 | 3.41 |
| Tiger Shark       | 263± | 338± | 384± | 432± | 472± | 524± |
| Pangasius hypophthalmus | 4.62 | 4.33 | 3.44 | 2.63 | 3.97 | 4.32 |
| Albino suckermouth | 43±  | 76±  | 72±  | 96±  | 116± | 160± |
| Hypostomus plecostomus | 2.33 | 2.54 | 1.73 | 3.96 | 2.44 | 3.87 |
| Clown catfish     | 93±  | 141± | 168± | 216± | 294± | 376± |
| Synodontis decorus | 1.16 | 1.25 | 2.44 | 3.47 | 2.98 | 3.78 |
| Black skirt widow tetra | 191± | 263± | 288± | 360± | 382± | 444± |
| Gymnocorymbus ternetzi | 1.56 | 2.22 | 3.51 | 3.44 | 4.65 | 4.88 |

**Primitive phase:** In this phase, different fish species showed different behaviours. Goldfish were gregarious and swim in grouped; rainbow shark swim back and forth, more than up and down; guppy, swordtail, widow tetra and tiger barbs were shown 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, swim 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 themselves at the top of the tank most of the time but occasionally they were harassed one another but nothing serious; golden gourami swim 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; T₁) for the albino suckermouth and higher (653±4.88 hrs; T₂) for the marble angel. These behaviours were seen earlier in the treatment T₁ than the treatment T₂. This might be due to the comparatively suitable water quality (especially DO and free CO₂) in the treatment T₁ 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, angelfish, 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 angelfish 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). Tiger barbs and black skirt widow tetra were hanged out in a top corner of the aquarium and then swim 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 swim 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; T₁) for the albino suckermouth and higher (840±3.98 hrs; T₂) for the marble angel. These behaviours were seen earlier in the treatment T₁ than the treatment T₂. This might be due to the comparatively suitable water quality (especially DO and free CO₂) in the treatment T₂ 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

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Johnson et al. (1998)
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; T₁) for the albino suckermouth and higher (1022±4.02 hrs; T₂) for the marble angel. These behaviours were also seen earlier in the treatment T₁ than the treatment T₂.

**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; T₂) than the other species used for the experiment in the given condition. Comparatively lower survival (116±2.44 hrs; T₁) was seen for the albino suckermouth. It was also seen that, fishes were died earlier in the treatment T₁ than fishes of treatment T₂. This might be due to the comparatively suitable water quality (especially DO and free CO₂) in the treatment T₂ 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 (12-18cm) 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 CO₂ content were found in the treatment T₂ than the treatment T₁ in case of all experimental treatments.

Olufeagba et al. (1999) found the dissolved oxygen in his study ranges from 4.5-4.8mg/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 CO₂ 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 T₂ than the treatment T₁.

**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
again proved that aeriation systems 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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