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Toxicological Effects of Potassium Permanganate on Two Different Sizes of Angelfish (*Pterophyllum scalare*)

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Abstract: Potassium permanganate (PM) is a common therapeutic in ornamental fish. Acute toxicity (24-96h-LC_{50}) of PM was determined for angelfish (*Pterophyllum scalare*) at two size classes (2 and 10 g). Fish were exposed to different concentrations of PM and mortality was recorded thereafter, until 96 h. Exposed fish showed behavioral stress indicators. 24-96h-LC_{50} was calculated to be 1.87-1.1 mg/l for large fish and 0.64-0.35 mg/l for small fish. Results indicated that angelfish is susceptible to PM toxicity which its susceptibility is comparatively higher than many tested species. Toxicity of PM decreases with increasing fish weight from 2 to 10 g in angelfish. Higher tolerance in large fish compared to small fish might be as a result of increased stress resistance and higher quality of these fish compared to small fish as well as decrease in gill surface: body surface ratio as it was suggested that gills have more important role in osmoregulation in small fish compared to larger ones.

Key words: Potassium Permanganate · Angelfish · Toxicity · LC_{50}

INTRODUCTION

Potassium permanganate is a strong oxidant because of its derivative permanganate ion, MnO_4^{-2}. It is used as a common biocide at recommended concentrations up to 4 mg/l in various aquaculture settings. It is also used as a disinfectant in fish hatcheries for aquatic plants, aquaria, raceways, ponds and water supplies for removing fish parasites; reduce or prevent diseases, especially on wounds of fish; detoxification of fish toxicants such as rotenone and antimycin; for fungus and algae control; and to rectify temporary oxygen depletion problems in culturing ponds [1-3].

There are few works aiming to determine its toxicity on certain species [2-12]. However, these studies presented wide range for lethal concentration of PM, suggesting the need for evaluating its toxicity in any species, separately.

Angelfish (*P. scalare*) is an ornamental fish with high market demand. It is a common fish in ornamental fish stores. PM might be used in angelfish aquarium for several purposes including disinfecting, parasite removal and etc. it is necessary to determine PM acute toxicity in this species. Such information can help one to treat this species with a suitable dose. Thus the aim of the present work was to investigate the acute toxicity of PM on angelfish at two sizes (2 and 10 g).

MATERIALS AND METHODS

Total of 1000 fish (half of them with 2 g body weight and remaining with 10 g body weight) were purchased from a local ornamental fish store. Each size class was stored in a separate 500 L tank with continuous aeration for 15 days for acclimation. Fish were fed (~1% of body weight, once a day) by trout commercial pellet (Biomare, France; 0.5-0.8 mm in diameter). Water exchange was about 80% every other day. Photoperiod was 12:12 light: dark. Temperature was almost maintained constant (26±1°C). Dissolved oxygen and pH were > 6 mg/l and 7.89-8.01.

After acclimation, large (10 g) fish were subjected to 0, 0.2, 0.5, 1, 1.5, 2, 2.5 and 3 mg/l while small (2 g) fish were subjected to 0, 0.05, 0.1, 0.3, 0.5, 0.7, 0.9 and 1.1 mg/l

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PM. Mortality was recorded every 24 h. each concentration contains 3 aquaria with 25 fish pre aquarium. Test solutions were renewed every 24 h to avoid dilution. Fish were not fed during the test. Water quality was as acclimation period.

24-96h LC_{50} was determined using EPA Probit Analysis Program V. 1.5 for each group, separately. All data were accepted if calculated chi-square for heterogeneity was lower than the tabular value at the 0.05 level.

RESULTS

Fish body surface became brownish, 24 h after exposure, indicating oxidation of the body surface. Fish showed behavioral changes after PM exposure including: avoidance behavior, increase in opercular rate, hyper excitation. While time period of exposure was progressing, upside down orientation and imbalance swimming and finally, death was observed. No mortality was occurred in control groups during the experiment.

24-96h-LC_{50} values for large and small fish are shown in Table 1 and 2, respectively. 24-96h-LC_{50} was calculated to be 1.87-1.1 mg/l for large fish and 0.64–0.35 mg/l for small fish.

DISCUSSION

The previous studies demonstrated that intensity of PM toxicity depended on fish species, fish size, hardness, pH, salinity and chemical oxygen demand. Marking and Bills [5] showed 96h-LC_{50} of PM ranged from 3.6 and 3.45 mg/l for goldfish and common carp, respectively to 0.75 mg/l for *Ictalurus punctatus*. The work on Caspian roach, *Rutilus rutilus caspicus* showed 24h-LC_{50} for 1 and 3 g fish to be 3 and 2.8 mg/l, respectively [12]. Cruz and Tamse [6] reported LC_{50} of 1.47 mg/l in another cyprinid species *Chanos chanos* (3-5 g weight).

Da silva *et al*. [8] determined the toxicity of PM in *Colossoma macropomum* and reported 96h-LC_{50} value of 8.6 mg/l which is apparently much higher than present results. The reason might be due to higher weight of tested animal compared to the present study (59 vs. 2-10 g).

Another work performed by Ovie [11] on *Clarias gariepinus*. The author reported 96h-LC_{50} value of 3.02 mg/l (fish weight = ~6 g). However, exchange rate of test solution was 50% daily (instead of present study that exchange rate was near 100%), which might lead to test medium dilution and consequently higher value of LC_{50}.

LC_{50} values for PM was significantly low in the small fish compared to large ones (Table 1 and 2). In the case of fish size, there is no study on PM, exception of Taylor and Glenn [10] and Hoseini and Jafar Nodeh [12]. Taylor and Glenn [10] tested the toxicity of five therapeutics, including PM, on two size classes in rainbow trout, *Oncorhynchus mykiss,* Chinook, *Oncorhynchus tshawytscha* and Coho, *Oncorhynchus kisutch* salmon. Their results suggested that the effect of body size on the toxicity of chemical compounds varied depending on species (as well as type of chemical compound). While in *O. mykiss*, large group was more tolerant to PM than small ones, *O. kisutch* and *O. tshawytscha* showed contrary results. Hoseini and Jafar Nodeh [12] found decrease in PM toxicity in Caspian roach parallel to increase in fish size from 1 to 3 g. Our results showed that small angelfish in more susceptible to PM toxicity compared to larger ones. The reason of higher tolerance in large fish compared to the smaller ones might be due to higher metabolic rate in small fish compared to larger ones.

Table 1: Acute toxicity of potassium permanganate to large angelfish

	LC_{50} Concentration mg/L	95% confidence limits Lower	Upper	Slope ± S.E	Intercept ± S.E
24 h	1.87	1.7	2.0	7.0±1.1	3.1±0.3
48 h	1.54	1.4	1.7	8.8±1.3	3.3±0.3
72 h	1.4	1.3	1.6	10.1±1.6	3.4±0.3
96 h	1.1	0.9	1.2	5.8±0.9	4.8±0.2

Table 2: Acute toxicity of potassium permanganate to small angelfish

	LC_{50} Concentration mg/L	95% confidence limits Lower	Upper	Slope ± S.E	Intercept ± S.E
24 h	0.64	0.57	0.71	5.9±0.9	6.1±0.2
48 h	0.60	0.53	0.67	5.7±0.9	6.3±0.2
72 h	0.41	0.33	0.50	3.1±0.5	6.2±0.2
96 h	0.35	0.28	0.42	3.7±0.6	6.7±0.2

Observed behavioral changes suggest fish experienced stress as a result of PM exposure. Avoidance, high opercular rate, excitability and etc are behavioral signs of stress [13]. Previous studies showed stress responses due to PM exposure in *C. macropomum* [8] and *I. punctatus* [14]. Toxicity of PM is believed to target fish gill, since osmotic disturbance has been observed in salmons moving seaward following PM treatment [15]. However, underlying mechanisms have remained unknown, although it has been suggested that oxidative stress might be involved in toxicity of PM; since PM is strong oxidant, absorption of its appreciable concentrations by gill might cause oxidative stress, particularly in gill [16]. It is possible that higher tolerance to PM in larger angelfish be due to higher stress resistance in large fish or decrease in gill: body surface ratio. It was reported that gill play more important role in osmoregulation in smaller fish compared to larger ones [17].

CONCLUSION

It is concluded that angelfish is susceptible to PM toxicity and its susceptibility is comparatively higher than the other species. Accordingly, care should be taken when this chemical is used in the aquaria containing angelfish. Toxicity of PM decrease with increase in fish weight from 2 to 10 g in angelfish suggesting the need of more attention in younger individuals compared to older ones. Higher tolerance in large fish compared to small fish might be as a result of increased stress or decrease in gill surface: body surface ratio.

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