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IMMOBILIZATION EFFECT OF POTASSIUM DICHROMATE ON *DAPHNIA MAGNA* (STRAUS)

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ABSTRACT

In the present study, potassium dichromate was evaluated against an aquatic invertebrate, *Daphnia magna*. The control and test medium, physico chemical parameters *viz.*, temperature (21.2 -21.9°C), pH (6.3-6.7) and dissolved oxygen concentration (3.4 -3.7 mg/l) were within the limit for all trials. The potassium dichromate exhibited 100% immobility at 4 mg/l concentration for all the trials. There was no immobility observed at 0.125 mg/l concentration in 1st and 3rd trials but 2nd trial showed 6.6% immobility. More than 50% of immobility was recorded in 2 mg/l concentration in all the trials. The effective concentration of 1.3, 0.8 and 0.9 mg/l concentration were obtained for 1st, 2nd and 3rd trial respectively for 50% immobility. Our results indicate that the potassium dichromate was toxic to *D. magna*. In this research suggested that avoid contamination of the aquatic ecosystem for secure food chain of living organism.

Keywords: *Daphnia magna*, Effective concentration, less than 24 h old, Immobility.

INTRODUCTION

Zooplankton plays a vital role in maintaining the water quality and biodiversity in the aquatic ecosystem. They are robustly affected by ecological conditions and react quickly to alterations in water quality and it is the transitional between phytoplankton and fish [1]. Among the diverse zooplanktons, *D. magna* (Cladoceran) are small aquatic crustacean also known as water fleas. The physiological and biological activities such as movement, feeding distribution of aquatic organisms and reproduction are directly based on the water temperature, pH, salinity, total dissolved solids, dissolved oxygen and hardness. *Daphnia magna* reproduce parthenogenetically by producing eggs which are carried in the brood pouch and directly gives birth to young neonates [2]. The toxicity studies were usually carried out with less than 24 h old daphnids. The environmental stress and exposure of toxic chemicals during the neonatal stage may directly affect the growth of the neonates and indirectly reduces reproduction of *Daphnia*. Hence neonatal stage is the most sensitive [3].

Totally 15 different compounds was tested against three different *Daphnia* sp., such as *D. pulex, D. cucullata, D. magna* and found that *D. magna* is more sensitive comparatively [4]. In the field of aquatic toxicology, *D. magna* was commonly accepted as standard test system for testing the new chemicals [5]. Also some advance technic also used to measure toxic effect of esfenvalerate on immobilization of *Daphnia magna* by using Multi- DaphTrack system and Bbe® Daphnia Toximeter, the results revealed that the average speed of *Daphnia* was based on the exposure concentration and exhibited EC_{50} of 1.04 ±0.01 µg/l in Multi- DaphTrack system and 1.5 times faster swimming speed in Bbe® Daphnia Toximeter [6]. Potassium dichromate is readily soluble in water and hazards. The Potassium dichromate exhibited reproduction and acute immobilization toxicity to *D. magna* [7]. Above all this *D. magna* has short life span, rapid maturation and reproduction made them to select for testing chemicals by acute immobilization effect. Hence the present study

was assessed immobilization effect of potassium dichromate on *D. magna*.

MATERIALS AND METHODS

Daphnia magna culture

D. magna culture maintained at Bioscience Research Foundation (BRF), Chennai, India was used for the acute immobilization test and the test was performed according to OECD test guideline 202. The *D. magna* was cultured in potable water collected from the test facility. The healthy culture was maintained by periodical analyzes of water physico chemical parameters. The culture room was maintained with light intensity of 1130-1280 lux and temperature (18-22ºC). The daphnids were fed with known quantity of supernatant from the yeast fish feed mixed with water. The culture was considered thriving, when the daphnids reproduce continuously without any male production. During culture, F_1 generation was discarded and further generation broods are only maintained and used for the test. The less than 24 h old daphnids were used for toxicity test [8].

Water Parameters

Water parameters were the most important criteria for culture and acute immobilization test. The important water parameters such as temperature, pH and dissolved oxygen were analyzed [8].

Acute Immobilization Test

The acute immobilization test was carried out in the culture medium (potable water) with 4, 2, 1, 0.5, 0.25 and 0.125 mg/l concentration of Potassium dichromate with three replicate. The culture medium alone was considered as control. The treatment and control medium was subjected to analyze temperature, pH and Dissolved oxygen. In each beaker, 5 daphnids were released cautiously. Care was taken to avoid diluting the prepared concentration while releasing daphnids. Then the beakers are exposed under the light intensity of 1130-1280 lux for 16:8 hour light and dark at 18-22ºC for 24 hour. During the exposure period, daphnids are not fed. The water parameters are analyzed at the initial and final day of the experiment. The daphnids were observed for immobilization by gently agitating the beaker and the *Daphnia* which is unable to swim after 15 seconds are considered as immobile [8].

STATISTICAL ANALYSIS

The obtained data of immobility were subjected to statistical analysis and presented as mean ± SD. Effective concentration was calculated by using NCSS software.

Table 1. Acute immobilization effect of Potassium dichromate on *Daphnia magna*

Concentration (mg/l)	Immobilization (%)			Average immobility of trials
	1st trials	2nd trials	3rd trials	
Control	0.0±0.0	0.0±0.0	0.0±0.0	0±0
0.125	0.0±0.0	6.6±11.5	0.0±0.0	2.2±3.8
0.25	6.6±11.5	20.0±0.0	13.3±11.5	13.3±6.7
0.5	20.0±0.0	33.3±11.5	26.6±11.5	26.6±6.6
1	33.3±11.5	46.6±11.5	53.3±11.5	44.4±10.1
2	53.3±11.5	73.3±11.5	66.6±23.0	64.4±10.1
4	100.0±0.0	100.0±0.0	100.0±0.0	100±0

Mean± SD, with 3 replications (N- 15).

Table 2. Effective concentration (mg/l) of Potassium dichromate for acute immobilization on *Daphnia magna*

Trials	EC_{50}	95% confidential		EC_{90}	95% confidential	
		Lower limit	Upper limit		Lower limit	Upper limit
1	1.30	1.07	1.53	5.08	3.36	6.8
2	0.83	0.68	0.98	3.89	2.53	5.25
3	0.93	0.77	1.09	3.76	2.58	4.94
Average	1.02	-	-	4.24	-	-

RESULT AND DISCUSSION

Water parameters of control and treatments were within the limit on initial day. The temperature of the culture medium was 21.2, 21.5 and 21.6 ^{o}C on initial day and 21.9 and 21.4 ^{o}C on final day of 1st, 2nd and 3rd trials respectively. The pH of the medium was 6.4 to 6.8 on 0 h and 6.3 to 6.7 on 24 h of the all the trials. The dissolved oxygen of the culture medium was 3.5 to 3.7 mg/l on initial day and 3.4 to 3.7 mg/l on final day of the three trials. The immobilization percentage of daphnids was observed on 24 h. There was no immobility of daphnids in control. Immobility of daphnids was not occurred in the lowest concentration of 0.125 mg/l in 1st and 3rd trials and in 2nd trial showed 6.6% immobility. The 100% immobilization of daphnids was observed in the highest concentration of 4 mg/l in all the three trials. The lowest

immobilization percentage of 6.6 and 13.3 was observed at 0.25 mg/l concentration in 1st and 3rd trials respectively. The immobilization percentage was increased as the concentration increased Table 1. The EC_{50} values of three trials were 1.30, 0.83 and 0.93 mg/l respectively for 50% immobility. The average EC_{50} value of three trials was 1.02 mg/l Table 2. In the present study, EC_{50} value of the Potassium dichromate was 0.8 to 1.3 mg/l concentration for acute immobility. The present study coincide with earlier findings of Gopi *et al* [7] who reported that potassium dichromate exhibited LC_{50} value of 0.64 mg/l concentration for acute toxicity effect. Similarly, many workers also reported different chemicals on *Daphnia* sp. The immobilization of *Daphnia* was tested by using the nanoparticles and EC_{50} values were 0.622 mg/l for ZnO NPs and 114.357 mg/l for Al_2O_3 NPs [9]. The endocrine disrupting compounds such as dicofol, ketoconazole, flutamide and vinclozolin are evaluated against *Daphnia* for 48 h and found that the EC_{50} values were 0.2, 1.5, 2.7 and >3 mg/l respectively [10]. The toxicity of Chlorpyrifos, 3,5,6-trichloropyridinol (TCP) and chlorpyrifos+TCP was studied against *Daphnia* and the median lethal concentration were 0.24, 0.20 and 0.08 µg/l [11]. The toxic effect of carbofuran along with suspended solids was studied by Herbrandson *et al* [12] and results revealed that EC_{50} value was 92 µg/l.

In this study there was no mortality and immobility was noticed in control during study period. Similar result was obtained by Moreira *et al* [13] who stated no mortality and immobility observed in control but that single-walled carbon nanotubes (SWCNTs) showed effect on *D. magna*. In the present study Potassium dichromate exhibited 100% immobility of *D. magna*. Similar result observed by Mažuran *et al* [14] who reported that $CaBr_2$ was highly toxic to adults and embryos of *D. magna*. Similarly, Emmanuel *et al* [15] has studied the toxic effect of Sodium hypochlorite disinfected wastewater against *D. magna* and found that the formation of AOX (halogenated organic compounds) affects the aquatic organisms. In the present study, time and concentration increased the immobility of daphnids were increased. The results coincide with findings of Bhattacharjee *et al* [16] who reported that ZnS nanoparticle was exposed to *Daphnia* and mortality was directly proportional to exposure period and concentration.

CONCLUSION

The *D. magna* is the one of the suitable biological indicator in the aquatic ecosystem. In the present study potassium dichromate exhibit the 100% immobility of daphnid and it exhibited average EC_{50} value of 1.02 mg/l. It is highly toxic to environment and usage of potassium dichromate can be reduced in agricultural pesticides.

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CONFLICT INTEREST

The authors declare that they have no conflict of interest.

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