Application Study For Monitoring Pollution Of Aquatic Ecosytem

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SUMMARY

The present study explores the method of Environmental Protection Agency (E.P.A.) used for evaluation the toxicity of effluent into the recieving water. The study was applied on the effluent of pesticide mamufacturing plant using short term chronic toxicity test method for evaluation the effluent toxicity. The a quatic organism Ceriodophnia Dubia used as a detector at different effluent dilutions. The results indicated that the productivity of C. dubia were reduced due to toxicity of the effluent under investigation. We recommend the method of E. P. A. for evaluation the toxicity of various effluent in water resources.

INTRODUCTION

Contaminated fresh water ecosystems often contain a great variety of toxicants that may interact and mutually influence toxicity. However, the environmental risk of toxicants is still judged on the effects of individual compounds. *(1)*.

Mixture toxicity experiments reflect actual pollution of aquatic ecosystems in a more realistic way than that experiments in which toxicants are tested individually and can be of help in determining ecologically relevant water quiality criteria *(1,3)*.

Chemical - specific approaches for controlling toxicity are of limited value, primarily because many effluents, whether from municipal or industrial sources containing thousands of potentially toxic chemicals that may or may not be detected by routine chemical analysis. It is difficult to predict the effect of factors such as PH, hardness, dissolved organic carbon on toxicity of chemicals in effluents, for example, although measured concentrations of a chemical may be high, the bioavailability of the chemical may be low *(4)*.

In 1984, in an attempt to dissolve these problems, the U.S. Environmental Protection Agency *(5)* issued a statement recommending the use of whole effluent toxicity testing.

The present study focus a head light over the method recommended by

U.S.E.P.A, 1989 *(6)* for estimating the chronic toxicity of effluents and receiving waters using cladoceran (C.dubia) as test organism. Our study was done on the effluent of Denton pesticide company.

MATERIAL & METHODS

Effluents

Effluents in this study was collected from Denton pesticide manufacture plant (Denton Texas, USA). It was used in different concentrations (100%, 50%, 25%, 12.5%, 6.25%) beside a control group where reconstituted hard water (R. H. W.) was used . Also R. H. W. as diluting water was used to give the organism the chance to live in normal condition and to exclude the possibilities of additional toxicity of receving water.

Test organism (C. Dubia)

Ceriodaphnia dubia is an ideal test organism because it is a relatively sensitive organism that can be inexpensively tested thorugh a complete life cycle in a short period (one week). During a seven day toxicity test a newly hatched female will develop into an adult and produce three broods of offspring (neonates). It reproduce thorugh a process known as cyclic parthenogenesis (see diagram 1) . During favourable conditions a mictic females will given birth to a mictic females. When environmental conditions become adverse, mictic females and males will be produced which mate and an ephilppim containing a fertilized zygot are produced. The ephippium will hatch into an a mictic female when the environmental conditions become favorable, it begins a new cycle. For toxicity testing, laboratory cultures are maintained under favorable conditions so that all organisms are a mictic females *(6)*.

Reconstituted hard water (R. H. W.)

RHW prepared for culturing C. dubia in 50 liter bactbes as follows :

Chemical	Gm/50 liters
KCL	0.2
$MgSO_4$	3.0
$NaHCO_3$	4.8
$CaSO4.2H_2O$	3.0

The R. H. W. should have Ph between 7.4 and 7.8, hardness between 80 and 100 mg / LCa CO_3 and alkalinity between 60 - 70.

Synthetic food and Algae

Synthetic food used for feeding C. Dubia composed of Yeast - Trout chow - Cerophyl (Y.T.. C.) and Algae Selenastrum Capricorntum. It was prepared as described in ASTM document, 1988

(8).

Other materials used in this study are illustrated in Fig. (1 & 2).

Culturing Ceriodaphnia dubia

The culture was started with the number of organisms needed to the experiment. Each day the organism was transfered to fresh culture water and feed. This organism, at 25°C and with adequate nutrition produced its first brood on day 4, its second on day 5 and its thrid on day 7 (No neonate in the six day). We used 10 replicates per every concentration, put each one in a separate cup using randomized block technique . Neonates of each adult should be randomely distributed in a manner that the neonates of one adult should be randomely distributed in the whole concentrations (one neonate in each concentration). This technique would minimize statistical errors.

Data analysis were done with Toxstat / Datasys computer program designed to include the method suggested in the short term chronic tests *(6)*.

RESULTS

Table (1) : Total number of neonates produced by Adult. C. dubia in one week after cultured with R. H. W. and different effluent concentrations.

Effluent %	Number of neonates per replicate in one weekk									
	1	2	3	4	5	6	7	8	9	10
Control	30	32	28	28	32	34	30	24	31	30
6.25 %	32	33	26	25	28	31	30	30	27	33
12.50 %	31	25	28	29	27	33	33	31	27	22
25.00 %	31	32	27	29	26	26	26	26	27	27
50.00 %	29	29	27	25	28	28	26	25	26	30
100.00 %	11	17	29	26	16	28	13	17	21	20

Table (2) : Analysis of variance showing the difference between groups.

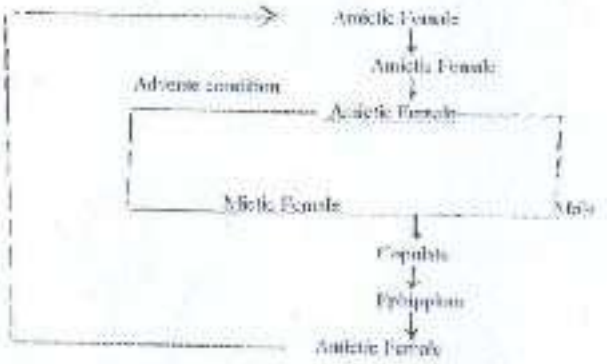
Source of variance	df	SS	MS	F. value
Between groups	5	969.88	137.98	11.12**
Within groups	54	970.30	12.41	

** Highly significant $P < 0.01$

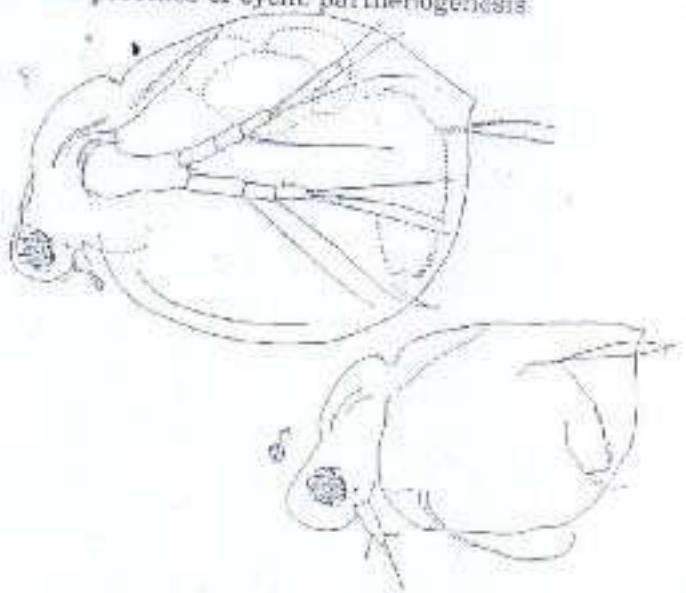
Table (3) : Statistical analysis for the number of neonates produced by Adult C. dubia in different groups.

Independent Variable	No. of cases	Range	Mean	±	SE
Control (RHW)	10	24 - 34	29.80 a		0.85
6.25 %	10	25 - 33	29.50 ac		0.91
12.50 %	10	22 - 33	26.60 ace		1.12
25.00 %	10	26 - 32	27.70 aceg		0.70
50.00 %	10	25 - 30	27.30 acegt		0.56
100.00 %	10	11 - 29	19.60 bdthj		1.96

Different letters sithin the same column are significant at $P < 0.01$



Daig. (1) : Explore the proceses of cyclic parthenogenesis



Daig. (2) : Shows a parthenogenetic female and a male . Notice the length of antennule of the female compared to that of the male (ref, No. 7).

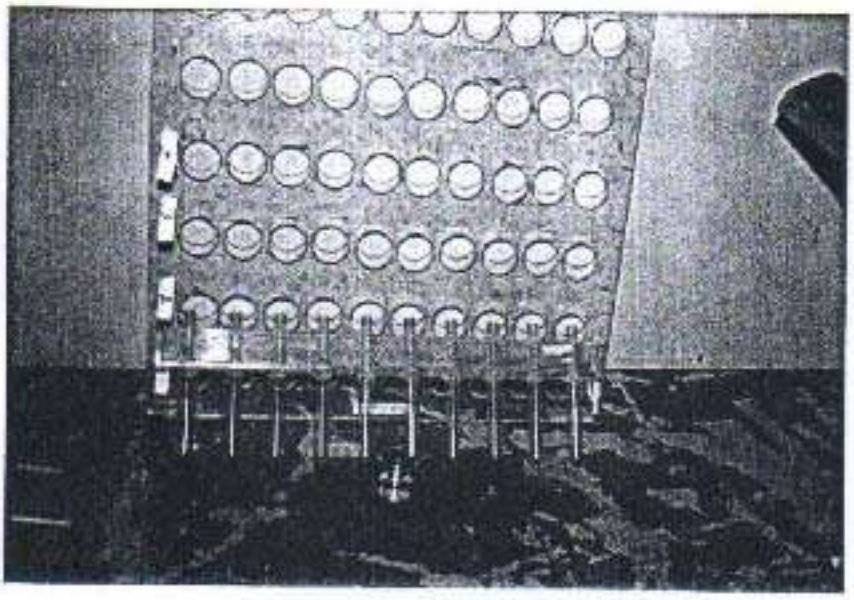


Fig. (1) : Shows the matrials used in the study (plastic board, culture cup, dispenser).

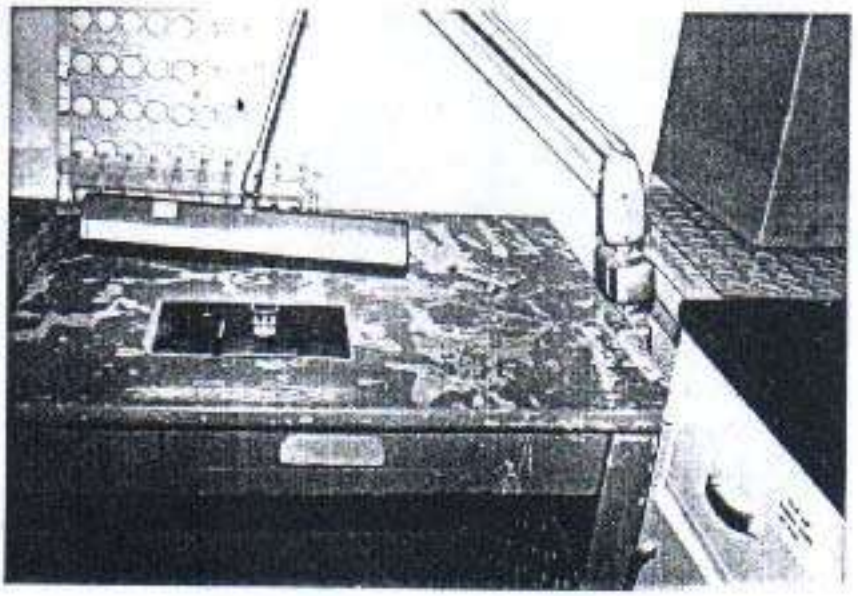


Fig. (2) : Shows the method of counting neonates of individual cultures under source of light.

DISCUSSION

In Egypt, although several studies were conducted regarding pollution of water sources whether from effluent of industtril sources *(12)* ; agricultural or municipal sources *(13)* , non of these studies dealt with mixture toxicity tests which are more realistic in determining toxicity of effluents .

The present study offer a simple , non expensive, short term chronic toxicity test method using the effluent of pesticide manufacturing plant as a model for evaluation of effuent toxicity on the productivity of aquatic organism Cerodaphnia dubia.

This study used the effluent of Denton pesticide plant in five concentrations (100%, 50%, 25%, 12.5% and 6.25%). Beside a control group contained reconstituted hard water (R. H. W.) . The data obtained in the current study were tabulated in table (1). Statistical analysis using toxstat database computer system (table 2,3) indicated that the average numbers of neonates produced by ten adult C. dubia in one week were 29.80 ± 0.85 ; 29.60 ± 0.91 ; 28.60 ± 1.12 ; 27.70 ± 0.70 ; 27.30 ± 0.56 and 19.80 ± 1.96 in the control group and the five concentrations (6.25 % ; 12.50 % ; 25% ; 50%; 100%) respectively.

These results shoud high significant reduction for neonates of C.dubia when cultured with 50% and 100% concentration of the effluent under expreiment when compared with neonates produced from C.dubia cultured with (R.H.W.) control group. Also a highly significant reduction in their number was recorded when the organism was cultured with 100% effluent in comparison with 6.25%; 12.50%; 25%; 50% effluent concentrations.These data indicates that the effluent under investigations has a chronic toxicity problem and should be treated before allowing to discharge into aquatic system.

In a conclusion. We recommend this test method as a simple, non expensiv,short term chronic toxicity test with the advantage of study a mixture of toxicant at the sam time which seems to be more realistic in determining actual pollution of aquatic ecosystem resources. Also we recommend this method for toxicity testing of other types of drinking water of newely constructed ground wells.

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الملخص العربى

دراسة تطبيقيه لإستكشاف سمية الملوثات فى مصادر المياه

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القينا الضوء في هذة الدراسة علي الطريقة التي اوصت بها منظمة حماية البيئة لاستكشاف سمية المخلفات التي تلقي في مصادر المياة حيث اجريت الدراسة علي مخلفات احد مصانع المبيدات وفي تخفيفات مختلفة ١٠٠٪، ٥٠٪، ٢٥٪، ١٢.٥٪ ، ٦.٢٥٪ . تمت دراسة تاثير هذة التركيزات علي انتاج الولدات في احد الكائنات المائية الدقيقة (الدافنيا) . اشارت النتائج ان هذة المخلفات أدت الي تقليل عدد صغار الدافنيا . اوصت الدراسة باستخدام هذة الطريقة في تقييم سمية المخلفات قبل القائها في مصادر المياة المختلفة نظرا لما يتميز بة هذا الاختبار من انه يستغرق وقت قصير جدا لدراسة التاثير المزمن للمخلفات .ايضا يعتبر اختبار قليل التكلفة ، سهل القيام به ، ويمكن بة دراسة سمية المخلفات في حالة وجود عدد من المواد السامة مجتمعة في آن واحد بغض النظر عن وجود علاقة بين هذة المواد سواء تزدي الي زيادة او تقليل سمية بعضهم البعض .