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Acute Toxicity of Pesticides to *Gobius sp.*, *Palaemonetes africanus*, and *Desmocaris trispimosa*

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Pesticides are employed to kill pests that compete for food supply with man. These pests either eat farm crops, agricultural products or render these products unpalatable for man. Many of the chemicals used are however not selectively harmful to pests, but are generally toxic to many non-target species including humans (in case of accidental exposure or suicide attempts), and other desirable forms of life that live together in the environment. Most pesticides are hydrophobic and hence their solubility and biodegradation become difficult with the result that they persist in the biological tissues and the environment for a long time. Pesticide residues have been reported in freshwater ecosystems (Thome and Thome, 1982). Marcelle and Thome (1983) determined the 96-hr LC_{50} of lindane to gudgeon, Gobio gobio, and also found a dose dependent lindane concentration in the liver, brain, and muscles of fish exposed to various concentrations of lindane. The use of DDT has been restricted by the Environmental Protection Agency of the United States of America. It has also been found with its metabolites in measurable amounts in insects, snails, crustasceans, leeches and fish (Heckman 1981).

Some investigators have reported that agricultural workers have higher death rates from malignant brain tumours (Delzell and Grufferman, 1985) compared with general population. Agricultural workers and pesticide applicators have also been shown to have increased risk for testicular cancer (Wiklund et al., 1986). Pesticides are also known to induce microsomal enzymes in animals (Remmer, 1972; Kolmodin et al., 1969) and certain organophosphate pesticides have been reported to cause a delayed polyneuropathy (Lotti, 1986).

In Nigeria and other developing countries, hundreds of pesticide formulations are being sold and used for agricultural, vector and pest control with little or no information as to their chemical composition and toxicity. We report the screening of some of the commonly used pesticides in Nigeria.

MATERIALS AND METHODS

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Five pesticides were used for the study - Igran combi (Terbutryn + Metolachlor), Avirosan (Dimethametryn + Piperophos), (Herbicides) and Diazinon were obtained from Swiss - Nigeria Chemical Company; Lindane and cypermethrin were obtained from Chemical and Allied Products Ltd., Apapa, Lagos. All these were research grade samples.

Fresh water organisms - Gobius sp. fingerlings and Desmocaris trispimosa were obtained from River Epe near Lagos, while the brackish water organisms - Palaemonetes africanus were obtained from Lagos lagoon. In all these cases, the transport and upkeep of the organisms were in accordance with those of Ward and Parish (1982).

A 0.1% solution of each pesticide was made in distilled water, from which calculated volumes were taken and diluted to 5L with preaerated fresh or brackish water. The concentrations were calculated as uL/L. Each experiment was begun by introducing ten organisms (Gobius sp. fingerlings, Desmocaris trispimosa or Palaemonetes africanus juveniles) into the test chambers containing the test chemical within 30min of its preparation. Mortalities were recorded at intervals including 12, 24, 48, 72 and 96 hr. Control experiments with just test water (fresh or brackish) containing no pesticide were also set up. The whole experiment was repeated if more than 10% mortality occurred in the control experiment. Median lethal concentrations (LC_{50}s) were calculated after transforming the cumulative response to probit values and concentration to Log values by method of Litchfield and Wilcoxon (1949). Test solutions were however renewed daily to discard accumulated metabolites and also to forestall loss of active toxic ingredient due to evaporation. Water quality of test water used in this study was as follows: Dissolved oxygen (D.O) at the beginning of each experiment was 8.1ppm, and 4.3ppm at 24hr (test media were renewed every 24hr); conductivity was 90.0 and 38,000 umhocm^{-1} for fresh and brackish water respectively; Salinity was not detected for fresh water and was 17mg/L for brackish water; Alkalinity was 20.40 and 60.00mg/L ($CaCO_3$) for fresh and brackish water respectively.

RESULTS AND DISCUSSION

From Table 1 it will be observed that the insecticides Lindane and Basudin (Diazinon) are very toxic to these organisms with LC_{50}s ranging from 0.04 - 0.25uL/L. Avirosan (dimethametryn and piperophos), which is a herbicide usually applied to rice fields to kill annual dicots and grass weeds was also toxic to the organisms with a 96-h LC_{50} value of 0.255uL/L. Cypermethrin which is an oil based insecticide was found to exert the least toxic effect of all the pesticides tested. This might probably be due to its partial solubility in aqueous medium.

From Table 2, the insecticides - Lindane, Diazinon and Cypermethrin showed high toxicity. Also P africanus showed more susceptibility to the toxicants than the fresh water Gobius sp. fingerlings as the toxicity levels of the toxicants are one thousand fold higher in the crayfish.

Table 1 Median lethal concentrations - LC50s (uL/L) and their confidence limits (in parentheses) obtained with test chemicals on Gobius sp fingerlings.

Test Chemical	LC50 (ul/L) 24hr	48hr	72hr	96hr
Avirosan	0.56 (0.53-0.59)	0.41 (0.38-0.43)	0.26 (0.23-0.28)	0.26 (0.23-0.28)
Lindane	0.41 (0.38-0.46)	0.41 (0.38-0.46)	0.30 (0.30-0.33)	0.25 (0.23-0.28)
Igran combi	3.52 (3.03-4.08)	3.03 (2.61-3.53)	2.18 (1.77-2.39)	1.95 (1.77-2.15)
Cypermethrin	208.8 (188.1-221.3)	149.2 (112.0-168.6)	88.7 (78.9-99.6)	28.1 (22.2-35.5)
Diazinon	0.14 (0.13-0.15)	0.04 (0.03-0.05)	0.04 (0.03-0.05)	0.04 (0.03-0.05)

Table 2 Median lethal concentrations - LC_{50}s (uL/L) with confidence limits in parentheses obtained with test Chemicals on P. africanus.

Test Chemical	LC_{50} (uL/L x 10^{-3}) 24hr	48hr	72hr	96hr
Lindane	8.14 (7.33-9.35)	5.50 (4.92-6.07)	3.42 (3.13-3.74)	3.39 (3.31-4.00)
Diazinon	61.36 (59.01-63.81)	25.96 (24.41-27.62)	22.94 (21.51-24.45)	17.93 (14.70-20.12)
Igran combi	266.07 (221.54-314.5)	101.15 (92.31-110.90)	46.66 (41.77-52.13)	30.90 (28.22-33.83)
Cypermethrin	6.31 (5.48-7.26)	5.34 (5.01-5.09)	3.53 (3.04-4.09)	3.53 (3.04-4.09)
Avirosan	6.21 (5.50-7.01)	5.08 (4.50-5.73)	3.42 (3.05-3.84)	3.36 (3.01-3.77)

With Desmocaris trispimosa as test organism, these toxicants exhibited high toxicity. This is found to be the same order with P.

Table 3 Median lethal concentrations - LC_{50}s (uL/L) with confidence limits in parentheses obtained with test chemicals on Desmocaris Trispimosa.

Test Chemical	LC50 (uL/L) x 10^{-3}			
	24hr	48hr	72hr	96hr
Lindane	8.09 (7.44-8.79)	6.85 (6.30-7.45)	5.08 (4.67-5.52)	3.94 (3.36-4.15)
Diazinon	69.66 (64.51-75.50)	31.62 (29.28-34.15)	23.98 (22.21-25.91)	20.75 (19.21-22.41)
Igran Combi	281.11 (236.22-334.5)	72.27 (65.46-79.84)	41.02 (37.16-45.28)	30.06 (27.23-33.19)
Cypermethrin	16.67 (15.43-18.07)	7.65 (7.08-8.27)	5.46 (5.05-5.91)	4.20 (4.01-4.65)
Avirosan	6.21 (5.5-7.01)	5.08 (4.50-5.73)	3.42 (3.05-5.84)	3.36 (3.03-3.77)

africanus with a correlation coefficient of 0.9939 of their 96-hr LC_{50}s.

The use of pesticides endangers man in two ways - direct effect due to exposure to the pesticides and indirect effect due to incorporation of pesticides in the food chain. For now it seems very necessary to develop biological control measures that will introduce viruses and juvenile insect hormones into the environment as part of an integrated pest control programme. This combines biological and chemical methods in pest eradication. From this study it could be seen that most of the pesticides used in our environment are very toxic to marine biota and hence could be injurious to man who depends largely on these aquatic organisms as source of food. In a country like Nigeria, there should be a policy whereby every chemical to be used in our environment should be screened for its toxic potential before license is granted for its use.

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