

**Chemical Structure and Acute Toxicity of
Thirteen Insecticides On Two Marine Clams:
Tapes decussata and *Venerupis aurea***

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ABSTRACT

Thirteen insecticides including four organophosphates; five synthetic pyrethroids, two oxime carbamates, one organochloine hydrocarbon and one antimoulting agent were compared for their acute toxicity in terms of 96hr. LC₅₀ against two edible economically important clams (bivalves) *Tapes decussata* and *Venerupis aurea*. Generally, *Tapes decussata* was more susceptible to these insecticides except for endosulfan and difluobenzuron to which *Venerupis aurea* was particularly more sensitive,. The molar LC₅₀ values were calculated by dividing the absolute LC₅₀ Value in mg/l by the respective molecular weight of each compound. It is anticipated that the molar LC₅₀ values will be more precise in attributing the acute toxicity to the molecular structure.

The comparison revealed that the presence of halogen in general and chlorine in particular are always correlated with hazard potential to the tested marine clams. Therefore chlorpyrifos was the more toxic followed by profenofos: in the four screened OP's. Similarly, cypermethrin, fenvalerate and deltamethrin were the more toxic synthetic

pyrethroids followed by, tetramethrin, and permethrin in a descending order. The presence of cyanide moiety in cypermethrin fenvalerate and deltamethrin supported their relative higher toxicity of class II of the synthetic pyrethroides. Endosulfan containing six Cl, was found to be of high toxicity especially to *Venerupis aurea*.

Difluobenzuron contains also Cl and F, and was relatively of higher toxicity especially to *Venerupis aurea*. The order of relative toxicity was changed according to the variation in molecular weight. Thus it can be concluded that acute toxicity is important to be screened for each compound on various marine biota to detect the potential hazard of pesticides as environmental pollutants.

INTRODUCTION

According to Butler and Springer (1963), the chemical damage to non-target organisms is not new, and studies were conducted by the U.S. and Wildlife service and other Federal and State agencies in coastal environments. The Bureau of Commercial Fisheries, Fish and Wildlife services, has laboratory investigations of the relationship between pesticides and coastal fish and shellfish poisoning cases.

The large scale field application of pesticides by land or aerial equipment will contaminate coastal areas either directly through atmospheric or water runoff transport of the pesticide residues.

The chlorinated hydrocarbon insecticides were known as severe killers of marine biota through their extreme acute toxicity and also its persistence in the aqueous environment where it is stored by adsorption on the sediments. Although, organophosphorous insecticides are strong toxicants but they are considered less persistent in the environment. However, it has been found, that parathion, may contaminate watersheds for as long as nine months after orchard applications (Nickolson et al., 1962). Analysis showed that parathion was transported by runoff and concentrated in lowlands and pond muds.

Butler and Springer (1963) emphasized that considerable species and individual differences exist in tolerance to the various pesticides. Consequently, results are not necessarily predictable on the basis of work with related compounds, usually each chemical must be evaluated. They specifically indicated that the pesticidal effects on oysters, clams and mussels may be less obvious, because the adult forms (snails) being sedentary, benthic inhabitants, bottom eaters, they cannot flee from the pesticides-contaminated areas in the sediments. They added, that chlorinated hydrocarbons are the most toxic pesticides tested in laboratory where they cause a 50% decrease in shell growth in 96 hours at concentrations ranging from 0.007 to 0.5 ppm depending on the compound. Lindane, organophosphorous, and carbamate insecticides and herbicides were much less toxic. Loosanoff *et al.*, (1957) found that larvae of oysters were more susceptible than adults to DDT, all larvae died in 96 hrs at 1ppm.

Kent and Johnson (1979) stressed that measuring pesticides in water alone does not determine the safety of fish or marine biota population in a given habitat. Both water and sediments should be analyzed to give accurate pesticide pollution index. In Britain it has been recommended that standard measurements of toxicity be carried out on each new pesticide, Manufacturers are asked to submit acute and long term toxicity data of each new insecticide as a requirement for its registration (Alabaster and Abram (1965).

Fairchild *et al.*, (1992) described the aquatic hazard assessment of the Organophosphorous Insecticides on fish and aquatic invertebrates such as daphnia.

Eisler and Jacknow (1985) concluded that toxaphene is extremely toxic to fresh water and marine biota, and was considered a major cause of Nationwide fish kills in 1977 (Anderson, (1982). They concluded that the 96 LC₅₀ on the Eastern Oyster *Crassostrea virginica* was 16 ppb, while on Quahog Clam, embryo *Mercenaria mercenaria* was 1120 ppb. This indicated the relatively high tolerance of clams.

Therefore, the present study was planned to screen the toxicity of insecticides to two of the economic marine edible clams *Tapes decussata* and *Venerupis aurea* which are mass produced for exportation at Tamsah lake in Ismailia.

MATERIALS AND METHODS

Tested Pesticides:

Technical pure samples from the following pesticides were used in this investigation:-

Organophosphorous Compounds :-

Chlorpyrifos : $C_9H_{11}Cl_3NO_3PS$ (M.W. 350.6) O,O,-diethyl O-3,5,6-trichloro -2-pyridyl phosphorothioate.

Fenitrothion: $C_9H_{12}NO_3PS$ (M.W. 277.2) O,O-dimethyl O-4-nitro-m-tolyl phosphorothioate

Pirimiphos-methyl: $C_{11}H_{20}N_3O_3PS$ (M.W. 305.3) O-2-diethylamino-6-methyl pyrimidin-4-yl O,O dimethyl phosphorodithioate.

Profenofas : $C_{11}H_{15}BrClO_3PS$ (M.W. 373.6). O-4-bromo - 2-Chlorophenyl O-ethyl S-n-propyl phosphorothioate.

Synthetic Pyrethroids:

Permethrin: $C_{21}H_{20}Cl_2O_3$ (M.W. 391.3) 3-phenoxybenzyl (IRS, 3RS; IRS, 3SR) -3- (2,2-dichlorovinyl)-2,2=dimethyl. Cyclopropanecarboxylate.

Cypermethrin : $C_{22}H_{19}Cl_2NO_3$ (M.W. 416.3) (RS)- α - cyano-3-phenoxybenzyl (IRS; 3 RS; IRS; 3SR)-3-(2,2-dichlorovinyl) - 2,2=dimethyl cyclopropanecarboxylate.

Fenvalerate: $(C_{23}H_{22}Cl NO_3)(M.W.419.9)(RS)-)\alpha$ - cyano-3-phenoxybenzyl (RS)-2 (4-chlorophenyl)-3-methyl butyrate.

Deltamethrin: $C_{22}H_{19}Br_2NO_3$ (M.W. 505.2) (S)- α - cyano-3-phenoxybenzyl (IR,3R)-3-(2,2-dibromovinyl)-2,2-dimethyl-cyclopropanecarboxylate.

Tetramethrin: $C_{19}H_{25}NO_4$ (M.W. 331.4) Cyclohex -1- ene-(20dicarboximidomethyl (IRS; 3RS; IRS; 35R)-2,2-dimethyl-3- (2-methylprop-1-enyl)=cyclopropane carboxylate.

Oxime Carbamates:

Aldicarb: $C_7H_{14}N_2O_2S$ (M.W.190.3)-3-methyl-2-(methylthio) propionaldehyde O-methylcarbamoyloxime.

Methomyl: $C_5H_{10}N_2O_2S$ (M.W. 162.2) S-methyl N-(methylcarbamoyloxy) thio-acetamidate.

Chlorohydrocarbons:

Endosulfan: $C_9H_6Cl_6O_3S$ (M.W.406.9) (1,4,5,6,7,7-hexachloro – 8,9,10-trinorborn-5-en-2,3 ylenebis-methylene) sulphite.

Antimoulting agents:

Diffuobenzuron: $C_{14}H_9ClF_2N_2O_2$ (M.W.310.7) 1- (4-Chlorophenyl) -3-(2,6-difluorobenzoyl)- urea.

Bioassay Organisms:-

The benthic bivalves of molluscs fauna of marine Vaneridae snails : Venerupis aurea and Tapes decussata were used as bioassay organisms.

The shell length was measured to the nearest 0.1 cm. This length was considered as an index of size and age of the animals. The average shell length of Venerupis aurea was 2.5 - 3 cm and for Tapes decussata was 2.8 - 3.1 cm. At these measurements, it was easy to detect and collect them accurately in pelagic areas. These clams were made available from lake Timsah at Ismailia.

Acute toxicity testing:-

The marine benthic bivalves (2 species) were transferred with sea water, in big containers saturated with oxygen until arrival to the Lab., at Alareesh; clams were then transferred to a new sea-water in a 25 liter glass aquaria and adaptation took place to the lab. conditions for at least 10 days before testing. In each glassbeaker (1L capacity), 10 clams were used in each replicate and 2 replicates were used for each concentration. The sea water was also used for dilutions to one liter in each replicate. That work was done for each tested species. The tests were repeated and the average of mortality counts were recorded after 96 hrs. By using the concentration/mortality data, logarithmic probits relationships were expressed in log/probit regression lines.

The corresponding 96 hrs LC_{50} 's with their confidence limits and regression line slopes were computed according to Finney (1971).

The bioassay technique adopted in this study complies with the standard procedure specified by the American Society for testing and Materials (ASTM)(Anonymous,1980).. The procedure was previously applied by Elsabae (1999).

RESULTS AND DISCUSSION

Relative Suceptibility of The Two Clam Species To The Tested Pesticides:

Tables (1, and 2) present the acute toxicity data of the two clams *Tapes decussata* and *Venerupis aurea* in terms of the 96 hr. LC_{50} values.

The comparison between tables 1, and 2 indicates that the marine clam *Tapes decussata* showed relatively higher susceptibility towards the tested pesticides than the second clam *Venerupis aurea* particularly when comparing the LC_{50} values of the four OP's, the five synthetic pyrethroids and the chlorinated hydrocarbon endosulfan and the antimoulting agent difluobenzuron. On the contrary, the clam *Venerupis aurea* was more susceptible to the two oxime carbamates aldicarb and

methomyl. These variations reflects specificity differences between the two species. Besides, chlorpyrifos was always the more toxic of the tested four organophosphorous compound against the two clam species, followed by profenofos, fenitrothion, and pirimiphos-methyl in a descending order.

Table (1): Acute Toxicity of Different Insecticides to the Marine clam *Tapes decussata*.

Tested Insecticides	96 hr LC ₅₀ ppm	Slope	Confidence Limits 95%
Chlorpyrifos	6.6	0.390	1.23×10^{-6} — 3.54×10^{-5}
Fenitrothion	56.0	0.522	1.004×10^{-5} — 3.0×10^{-4}
Pirimiphos methyl	160.0	0.707	2.98×10^{-5} — 8.59×10^{-4}
Profenofos	35.0	0.528	6.52×10^{-6} — 1.88×10^{-4}
Permethrin	300.0	0.667	5.59×10^{-5} — 1.61×10^{-3}
Cypermethrin	2.5	0.361	4.66×10^{-7} — 1.34×10^{-5}
Deltamethrin	90.0	0.543	1.68×10^{-5} — 4.83×10^{-4}
Fenvalerate	25.0	0.496	5.41×10^{-6} — 1.15×10^{-4}
Tetramethrin	190.0	0.615	3.54×10^{-5} — 1.02×10^{-3}
Aldicarb	280.0	0.795	6.91×10^{-5} — 1.14×10^{-3}
Methomyl	450.0	0.788	9.7×10^{-5} — 2.08×10^{-3}
Endosulfan	4.5	0.360	1.11×10^{-6} — 1.8×10^{-5}
Di fluobenzuron	0.45	0.296	9.32×10^{-8} — 2.68×10^{-6}

Similarly, cypermethrin was the more toxic compound of the tested five synthetic pyrethroids against the two clam species; followed by fenvalerate, deltamethrin, tetramethrin and permethrin in a descending order. The more acute hazardous compound to *Tapes decussata* was difluobenzuron; while that to *Venerupis aurea* was cypermethrin. This

specificity in the toxic action coincides with the conclusion of Butler and Springer (1963) who stated that considerable species and individual differences exist in tolerances to various pesticides. They added that each chemical must be tested separately without generalization. Thus the wide variations in specificity necessitate that each chemical in the environment must be screened to evaluate its real hazard to the economic nontargets as the edible marine clams.

Table (2) : Acute Toxicity of Different Insecticides To The Marine Clam *Venurupis aurea*

Tested Insecticides	96 hr LC ₅₀ ppm	Slope	Confidence Limits 95%
Chlorpyrifos	30.0	0.410	5.56×10^{-6} — 1.61×10^{-4}
Fenitrothion	160.0	0.353	2.98×10^{-5} — 8.59×10^{-4}
Pirimiphos methyl	500.0	0.370	932×10^{-5} — 2.68×10^{-3}
Profenofos	40.0	0.605	7.45×10^{-6} — 2.15×10^{-4}
Permethrin	250.0	0.464	4.66×10^{-5} — 1.34×10^{-3}
Cypermethrin	6.0	0.311	1.12×10^{-6} — 3.22×10^{-5}
Deltamethrin	60.0	0.365	1.3×10^{-5} — 2.4×10^{-4}
Fenvalerate	20.0	0.430	4.33×10^{-6} — 9.24×10^{-5}
Tetramethrin	150.0	0.462	3.9×10^{-5} — 5.7×10^{-4}
Aldicarb	30.0	0.407	6.5×10^{-6} — 1.39×10^{-4}
Methomyl	35.0	0.352	7.58×10^{-6} — 1.62×10^{-4}
Endosulfan	220.0	0.539	4.1×10^{-5} — 1.8×10^{-3}
Difluobenzuron	70.0	0.375	1.3×10^{-5} — 3.76×10^{-4}

Molar LC₅₀ Values As a More Precise Criteria for Relative Toxicity:

Tables (3, and 4) show the variation in the molecular weight of the compared thirteen pesticides. The absolute LC₅₀ values in ppm were converted to the corresponding molar LC₅₀ values by dividing the LC₅₀

figure by its respective molecular weight. Because the active units in the biological systems responsible for inducing the toxic action is the actual molecules of each compound; therefore the molar LC₅₀ values are considered the more precise criterion for comparing relative toxicities (El-Sebae, 1963, and El-Sebae, 1999).

Table (3): Molar 96 hr LC₅₀'s of Different Insecticides On The Marine Clam *Tapes decussata*

Tested Insecticides	96 hr LC ₅₀ ppm	Relative Order of Toxicity	Mol. weight	Molar 96 hr LC ₅₀ values	Order of Toxicity
Chlorpyrifos	6.6	4 <u>st</u>	350.6	0.0188	4 <u>th</u>
Fenitrothion	56.0	7 <u>rd</u>	277.2	0.2020	8 <u>th</u>
Pyrimiphos methyl	160.0	9 <u>th</u>	305.3	0.5240	9 <u>th</u>
Profenofos	35.0	6 <u>th</u>	373.6	0.0936	6 <u>th</u>
Permethrin	300.0	12 <u>th</u>	391.6	0.7660	11 <u>th</u>
Cypermethrin	2.5	2 <u>nd</u>	416.5	0.0060	2 <u>nd</u>
Deltamethrin	90.0	8 <u>th</u>	505.2	0.1781	7 <u>th</u>
Fenvalerate	25.0	5 <u>th</u>	419.9	0.0595	5 <u>th</u>
Tetramethrin	190.0	10 <u>th</u>	331.4	0.5733	10 <u>th</u>
Aldicarb	280.0	11 <u>th</u>	190.3	1.4714	12 <u>th</u>
Methomyl	450.0	13 <u>th</u>	162.2	2.7743	13 <u>th</u>
Endosulfan	4.5	3 <u>rd</u>	406.9	0.0110	3 <u>rd</u>
Di-fluobenzuron	0.45	1 <u>st</u>	310.7	0.0014	1 <u>st</u>

The differences in the molecular weights was reflected in changing the order of relative toxicity of the compared thirteen pesticides against both *Tapes decussata* and *Venerupis aurea* as shown in Tables 3 and 4. When the molecular weight is relatively smaller this will rank the toxicity to a relatively lower order. Changes in order of toxicity were

quite obvious in Table(4), because of the variation between the LC_{50} 's which was not broad enough, However, the more potent compounds kept the same order of toxicity because they have higher molecular weights and the variation in the LC_{50} 's far exceed the differences in the molecular weight.

Table (4): Molar 96 hr LD_{50} 's of Different Insecticides On The Marine Clam *Venerupis aurea*.

Tested Insecticides	96 hr LC_{50} ppm	Relative Order of Toxicity	Mol. Weight	Molar 96 hr LC_{50} values	Order of Toxicity
Chlorpyrifos	30.0	3 <u>rd</u>	350.6	0.0856	3 <u>rd</u>
Fenitrothion	160.0	9 <u>th</u>	277.2	0.5772	11 <u>th</u>
Pirimiphos methyl	500.0	12 <u>th</u>	305.3	1.6377	13 <u>th</u>
Profenofos	40.0	5 <u>th</u>	373.6	0.1070	4 <u>th</u>
Permethrin	250.0	11 <u>th</u>	391.3	0.6388	12 <u>th</u>
Cypermethrin	6.0	1 <u>st</u>	416.5	0.0144	1 <u>st</u>
Deltamethrin	60.0	6 <u>th</u>	505.2	0.1188	5 <u>th</u>
Fenvalerate	20.0	2 <u>nd</u>	419.9	0.0476	2 <u>nd</u>
Tetramethrin	150.0	8 <u>th</u>	331.4	0.4526	9 <u>th</u>
Aldicarb	30.0	3 <u>rd</u>	190.3	0.1576	6 <u>th</u>
Methomyl	35.0	4 <u>th</u>	162.2	0.2157	7 <u>th</u>
Endosulfan	220.0	10 <u>th</u>	406.9	0.5406	10 <u>th</u>
Difluobenzuron	70.0	7 <u>th</u>	310.7	0.2253	8 <u>th</u>

However, the importance and advantage of the molar LC_{50} 's is well demonstrated when comparing the rank order of toxicity of aldicarb and chlorpyrifos in Table (4) against *Venerupis aurea*. According to the absolute LC_{50} values both compounds has the same 3rd rank. Yet the

molar LC_{50} well differentiated between the two compounds where chlorpyrifos the higher mol. Weight kept the semi th rd rank while aldicarb became the six th.

Impact of Chemical Structure On Relative Toxicity

Comparison between the four OP's reveals that chlorpyrifos and profenofos were the more toxic. Both compounds are characterized by having more than one halogen atom in their molecular structure, particularly 3 chlorines in chlorpyrifos and one Cl and one Br in profenofos. The less toxic OP's fenitrothion and pirimiphos do not have any halogens. This may explain their relative less hazardous status. By comparing the tested five synthetic pyrethroids it can be deduced that compounds without the cyanide moiety are less hazardous as shown in permethrin and tetramethrin. On the other hand class II pyrethroids which contains the cyanide and halogens are expected to be higher in toxicity. This was well proved for cypermethrin which was the first toxic to *Venerupis aurea*, and the second toxic to *Tapes decussata*; it was followed by fenvalerate which contains one Cl. and then deltamethrin which contain 2 Br. Thus combination of CN and Cl favours the higher hazard. Role of chlorine was also demonstrated in the chlorinated hydrocarbon endosulfan which contain 6 chlorines and was the third in toxicity to *Tapes decussata*; and also the antimoulting compound difluobenzuron which contains one chlorine and two fluorines, and was the first in toxicity to *Tapes decussata*.

The proved toxiphoric and synergistic effects of the chlorinated moieties can be attributed to the high affinity of these chlorinated sites to block the sodium/ Ca^{+2} chloride ion channel requiring the release of neuro-transmitters such as GABA and glutamate at the axonal synapses leading to neurotoxic effects. Besides, the sodium/ Ca^{+2} , chloride channel neurons are known to regulate the cellular energy release by the enzyme groups of ATPases. This coincides with the reported inhibitory effect of ATPases by the synthetic pyrethroids and the chlorinated

hydrocarbons{Vijveberg *et al*, (1982); Ghiasudin and Matsumura (1979); Corbett *et al*, (1984); and Hassel (1990)}.

Few data are available in the literature dealing with marine clams or bivalves and the effect of their exposure to pesticides. However, their effects on other aquatic biota are relevant in this regard. Kent and Johnson (1979) correlated the organochlorine residues and the injury to aquatic biota in water and sediments of American Falls Reservoir. Jarvinen and Tyo (1978) showed the potential hazard of Endrin to Fish. Anderson (1982) reported the effects of fenvalerate and permethrin to non-target aquatic invertebrates. He proved that fenvalerate exceeds permethrin in its toxicity. A result which coincides with our present data stressing the role of CN moiety in enhancing toxicity.

Rubin and Soderlund (1992) indicated that the acute toxicity of the pyrethroid insecticides vary greatly across the phylogenetic lines, with fish being markedly hypresessensitive to pyrethroid intoxication (Bradbury, and Coats, 1989), Glickman and Co-Workers (1981), reported that rainbow trout eliminate and metabolize certain pyrethroids at slower rates than rats and chickens (Gaughan *et al.*, 1977, 1978). This metabolic variation explains the higher toxicity of pesticides to aquatic biota than to terrestrial mammals.

Coats and Jeffery (1979) studied the acute toxicity of four synthetic pyrethroids to rainbow trout and proved that the formulated E.C. forms are more toxic to the fish. This finding suggests that the formulated forms of pesticides should be used in the screening program, beside the pure technical samples to show the actual real hazard.

Webber *et al.*,(1992) concluded that field measurements on whole ecosystems are now a requirement of the U.S.EPA for pesticide registration to evaluate the potential hazard of the chemical to the environment.

Finally, the present investigation was targetting evaluation of the expected direct pollution hazards or runoff and waste water discharge polluted with pesticides. Generally it can be concluded that any relatively persistent or stable molecules containing halogen and/or cyanide moieties will be highly hazardous to marine biota including the edible bivalve clams which are recently of increasing economic importance.

REFERENCES

- Alabaster, J.S.; and F.S.H. Abram. Estimating The Toxicity of Pesticides To Fish. PANS (C) Vol. 11(2) June (1965)
- Anderson, R.L. effects of Fenvalerate and Permethrin on Nontarget aquatic in vertebrates USEPA. Environ. Res. Laboratory. Dulth, 6201 Congdon Boulevard, Dulth, Minnesota, pp 29 (1982).
- Anonymous. Standard Practice for conducting Acute Toxicity Tests with Fishes, macro invertebrate and amphibians. Amer Soc. For Testing and Materials E 729, March 3 (1980).
- Bradbury, S.P. and J.R. Coats. Comparative toxicology of the pyrethroid insecticides. Rev. environ. Contam. Toxicology. 108:153-177 (1989).
- Butler, P.A.; and P.F. Springer. Pesticides A New Factor In Coastal Environment. Transctions The 28th North Amrican Wildlife and Natural Resources Conference. March pp 378-390 (1963).
- Coats J.R. and N.L.O' Donnell-Jeffery. Toxicity of Foor Synthetic Pyrethriod Insecticides to Rainbow Troot. Bull.Environ. Contamn. Toxicol. 23: 250-255 (1979).
- Corbett, J.R.; K. Wright, and A.C. Baillie The Biochemical Mode of Action of Pesticides, 2nd Edition, Academic Press, pp. 382. London, (1984).
- Eisler, R.; and J. Jacknow. Toxaphene Hazards To Fish, Wildlife and Invertebrates : A synoptic Review. Biological Report 85(1-4). Fish and Wildlife Service, U.S. Dept. of Interior (1985).

- Elsabee, Ali, A.H. Molecular Structure and Acute Toxicity of Different Insecticides To Three Marine Fish Species. *J. Pest Cont. and Environ. Sci.* 7 (3): 19-30(1999).
- El-Sebae, A.H.; Molecular Correction Is Needed for Standardization of The Structure Activity Relationship. XVI International Congress of Zoology, Washington, August (1963).
- Fairchild, J.F.; E.E. Little; and J.N. Huckins. Aquatic Hazard Assessment. *Arch. Environ. Contamn. Toxicol.* 22: 275-279 (1992).
- Finney, D.J. Probit Analysis 3rd Edition London and New York, Cambridge Univ. Press. (1971).
- Gaughan, L.C.; R.H. Robinson and J.E. Casida. Distribution and metabolic fate of trans, and cis-permethrin in laying hens. *J. Agric. Food chem.* 26: 374-380 (1978).
- Gaughan, L.C.; T. Unai; and J.E. Casida. Permethrin metabolism in rats. *J. Agric. Food Chem.* 25: 9-17 (1977).
- Ghiasudin, S.M. and F. Matsumura. *Pestic. Biochem. Physiol.* 10: 152-161 (1979).
- Glickman, A.H.; R. Hamid; D.E. Richert. And J.J. Lech. Elimination and metabolic fate of permethrin isomers in rainbow trout. *Toxicol. Appl. Pharmacol.* 57: 88-95 (1981).
- Hassell, K. The Biochemistry and Use of pesticides, Structure, Metabolism, Mode of Action, and use in Crop Protection. pp. 534 (1990).
- Jarvinen A.W. and R.M. Tjo. Toxicity to Fathead Minnows of Endrin in Food and Water-*Arch. Environ. Contamn. Toxicol.* 7: 409-421 (1978).
- Kent, J.C.; and D.W. Johnson. Organochlorine Residues in Fish, Water, and Sediment of American Falls Research, Idaho 1974, *Pesticides Monitoring Journal.* Vol. 3 (1) 28-34 June (1979).
- Loosanoff, W.L.; J.E. Hanks; and A.E. Ganaros. Control of certain forms of zooplankton in mass algal cultures. *Science*, 125 (3257): 1092-1093 (1957).

- Nickolson, H.P.; H.J. Webb; G.J. Lauer; R.E. Obrein; A.B. Grzendo and D.W. Shanklin; Insecticide Contamination in a Farm Pond. Transactions of the American Fisheries Soc. 91(2): 213-222 (1962).
- Rubin, J.G. and D.M. Soderlund. Interaction of Naturally Occurring Neurotoxins and The Pyrethroid Insecticide Deltamethrin With Rainbow Trout (*Oncorhynchus mykiss*) Brain Sodium Channels. Environ. Toxicology and Chemistry Vol. 11; 677-685 (1992).
- Vijverberg, H.P.M.; Vander Zalm, J.M. and van der den Bercken. J. Nature, (London) 295: 601-603(1982).
- Webber, E.C.; W.G. Devtsch; D.R. Bayne; and W.C. Seesock. Ecosystem Level Testing of a Synthetic Pyrethroid Insecticide In Aquatic Mesocosms. Environ. Toxicology and Chemistry, Vol 11: 87-105 (1992).

الملخص العربي

التركيب الكيميائي والسمية الحادة لثلاثة عشر مبيداً على نوعين
من الجانطوفلي البحري *Tapes decussata* and *Venerupis aurea*

د. علي عبد الخالق المباعي

استاذ مشارك - قسم العلوم البيئية والموارد الطبيعية

كلية العلوم البيئية الزراعية بالعريش - جامعة قناة السويس - العريش - شمال سيناء

تم تقدير السمية الحادة لثلاثة عشر مبيداً حشرياً من المجموعات الكيميائية المختلفة ضد الافراد البالغة من نوعين من الجانطوفلي *Tapes decussata* and *Venerupis aurea* واشتملت المبيدات على اربعة مركبات فوسفورية عضوية وخمسة من البيريثرويدات المحضرة صناعياً - واثنان من مجموعة الاوكسيم كاربامات - والاندوسلفان من المركبات الهيدروكربونية الكلورة ومركب واحد من مانعات الانسلاخ وهو دايفلوبنزايرون. وبصفة عامة كان الجانطوفلي من نوع *Tapes decussata* اكثر حساسية

للمبيدات من النوع الثاني فيما عدا مبيد الأندوسلفان والدايفلوبيتريرون والتي كانت اشد سمية بصورة نوعيه على *Venerupis aurea*.

وفي محاولة دراسة العلاقة بين التركيب الكيميائي والستاتير السام تم تحويل قسم 96 hr LC₅₀ الى القيم الجزئية المقابلة لها بقسمة التركيز المتوسط للموت على الوزن الجزئي المقابل وذلك كوسيلة ادق لصحة المقارنة خاصة بين الجزيئات المتفاوتة في وزنها الجزئي وكذلك فان الصور الجزئية هي الوحدات الفعالة والمسئولة عن التأثير القاتل داخل الانسجة الحية وعلى ذلك فالتركيز الجزئي للمبيد قياس ادق للسمية الفعلية.

ومن اهم الاستنتاجات ان وجود الهالوجين بصفة عامة والكلور بصفة خاصة مرتبط بالسمية الاعلى ضد هذه الكائنات البحرية من القواقع ذات المصراعين من الجاندوفلي.

وظهر ذلك في السمية العالية لمبيد الدورسبان ويحتوي ثلاث ذرات كلور ويليهِ في السمية مبيد الكوراكرون (ويحتوي ذرة كلور وذرة بروم) اما مركبات البيريثرويدات فان مبيد السبيرمثرين كان اشدّها سمية (يحتوي ٢ كلور) يليهِ الفينفاليورات (يحتوى ذرة كلور) ثم الدلتامثرين (يحتوي ٢ بروم) بينما كانت المركبات الخالية اقل في سميتها بشكل واضح مثل التترامثرين والبيريثرين ثم عادت السمية العالية تصاحب مبيد الأندوسلفان (يحتوى ٦ ذرات كلور) ثم مبيد الديميلين ويحتوي ذرة كلور ، ٢ فلور.

ومن الملفت للنظر ان هذه المبيدات التي تحتوى الكلور والهالوجين تتميز بثباتها النسبي وقابليتها للتراكم في الانسجة الحية وامتصاصها السطحي على طبقات القاع لسنوات طويلة مما يؤدي للسمية المزمنة وما يترتب عليها من اعراض السمية الخلوية. وعلى ذلك فان اجراء المقارنة لاستكشاف السمية الحادة تصبح امرا مهما لكل مركب على كل من الكائنات البحرية ذات الاهمية الاقتصادية وللكشف عن السمية النوعية. ومناقشة النتائج على اساس القيم الجزئية للتركيزات السامة يعطى اماسا ادق في الكشف عن السمية الحادة بطريقة قياسية لامكان التنبؤ بمخاطر السمية المزمنة للملوثات البيئية.