Volume 23 | Issue 1 Article 4

1961

New Insecticides: Toxicity, Hazards, and Therapy

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Toxicity, Hazards and Therapy

Charles G. Wilber, Ph.D.*

REPEATED news accounts of the poisoning of small children and of pets by insecticides indicate that there is still a lack of information concerning the poisonous nature of these new, potent, economically valuable compounds.

Modern insecticides are essentially of two general kinds: chlorinated hydrocarbons and oganic phosphorus compounds. Among the former are: chlordane, dieldrin, aldrin, parachlorophenyl trichloroethane (DDT), heptachlor, toxaphene, benzene hexachloride (BHC, gammexane). Lindane is 99 per cent pure BHC.

The compounds are all of veterinary interest. Lindane is an effective agent against ectoparasites. Toxaphene is a general insecticide; its use in dairy barns or on milking animals is not recommended. Heptachlor is used to control cotton boll weevil; it is reported to cause liver damage in mammals. Aldrin is a general insecticide; it is too volatile to be used widely; it is reported to be a liver poison. Dieldrin is an effective general insecticide. Chlordane is particularly effective against fleas, lice, ticks, mange. These compounds are effective insect-killers; but they are also poisonous to warm-blooded animals (Table 1).

Table 1
Acute Oral Toxicity of Various Insecticides

	Doses in mg/kg	
Agent	Animal	LD50
Aldrin	Chick	10-15
Aldrin	Dog	95-105
Chlordane	Chick	220-230
DDT	Rabbit	300
DDT	Cat	400-600
Toxaphene	About 25 for most animals	
Dieldrin	Chick	22-25

Table 2
Maximum Safe and Minimum Toxic Oral Dose of Insecticides

	Dose in mg/kg		
Chemical	Animal	MSD	MTD
Aldrin	Sheep	10	15
BHC	Sheep	10	25
Chlordane	Sheep	50	100
DDT	Calves	100	250
Toxaphene	Sheep	10	25

Table 2 shows the maximum safe and minimum toxic dose of several chlorinated hydrocarbon insecticides for sheep and calves. Casualties from this group of insecticides are usually seen in small ani-

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mals. For example, cats are very susceptible to DDT. One should avoid the use of this insecticide on or around cats.

The precise mechanism by which the chlorinated hydrocarbon insecticides exert their toxic action in insects or in mammals is unknown. It is assumed that some enzyme system is disrupted. The nervous effects observed are probably peripheral in origin.

In addition to acute effects, the chlorinated hydrocarbons persist in body fat and give rise to chronic poisonings. There is evidence that fat animals are more resistent to poisoning than are thin ones.

Ordinarily, one of the first signs of poisoning by agents in this group of compounds is an increased activity and sensitivity of the affected animal. Large animals show evidence of blindness. Anorexia is a consistent feature. Toxic signs usually become apparent within about four to five hours after exposure.

Treatment depends on control of convulsions by means of short acting barbiturates, such as pentobarbitone. Prognosis is good unless ventricular fibrillation occurs. In small animals poisoned with DDT, the first ten to eighteen hours after initial signs appear is the critical period. If the animal survives for the first 36 hours, it will, in all probability, recover Complete recovery may take up to two months. If the poison is ingested it should be removed by *saline* purges. An oily purgative is contraindicated.

Commonly used organic phosphorus insecticides include: parathion, malathion, tetraethyl pyrophosphate (TEPP), diazinon, chlorothion and bayer compound. The toxicity of some of these compounds for cattle and sheep is shown in Table 3.

Table 3
Maximum Safe and Minimum Toxic Oral Dose of Insecticides

		Dose in mg/kg	
Chemical	**Animal**	**MSD**	**MTD**
Parathion	**Cattle**	**4**	**——**
Parathion	**Sheep**	**10**	**20**
Malathion	**Sheep**	**50**	**100**
Diazinon	**Sheep**	**20**	**30**
Chlorothion	**Calves**	**50**	**100**

Parathion is a very stable compound; it persists on plants for weeks after spraying. TEPP, on the other hand, hydrolyzes to relatively inocuous components in a few hours. Parathion is one of the most toxic of these insecticides (Table 4).

Table 4.
Relative Toxicities of Various Insecticides Taking Parathion (=1) as Base.
(The larger the index the less toxicity)

For Cattle	
Aldrin	**2.5**
BHC	**2.5**
Dieldrin	**2.5**
Chlorothion	**12.5**
Diazinon	**2.5**
For Calves	
DDT	**25.0**
Chlordane	**2.5**
Aldrin	**0.6**
Dieldrin	**1.3**
Malathion	**2.5**
Diazinon	**0.1**
Methoxychlor	**62.5**

The organic phosphorus insecticides are insidious; they may gain entry into the animal body by inhalation, through the skin and through the eyes or by ingestion. By all routes they are toxic. They exert their poisoning effect in insects and in warm-blooded animals by destroying the enzyme, cholinesterase. Excess acetylcholine then accumulates in the body, resulting in disorganization of the nervous system.

Diagnosis depends on the observation of characteristic signs and by estimation of erythrocyte cholinesterase activity. The signs of poisoning may be summarized as follows:

1. *Muscarinic effects;* salivation, sweating, bronchiolar constriction.
2. *Nicotinic effects;* peripheral muscular tremors, heart block, blood pressure effects.
3. *Central nervous effects;* convulsions, central depression of respiration.

Death results from anoxia.

The level of cholinesterase activity of the erythrocytes can be estimated rapidly in the field with a simple color test using bromthymol blue as an indicator.

The treatment of organic phosphate poisoning in animals, and in man, can be effective but must be instituted without

delay. The skin, if contaminated with insecticide, must be thoroughly cleaned with copious amounts of water and soap if available. Atropine sulfate should be administered in large doses intramuscularly or intravenously until signs of atropinization are evident (dilated pupils, dry mucous membranes, increased heart rate). For a medium sized dog the initial dose of atropine after poisoning, would be 2 mg intravenously, followed by additional doses as needed to produce atropinization. For cattle, the initial dose should be 0.15mg/kg intravenously. As an adjunct to atropine, pyridine-2-aldoxime methiodide (2-PAM) in a dose of 5 mg/kg body weight is most effective. 2-PAM with atropine has been shown effective therapy against several hundred LD50's of organic phosphorus compounds in mammals. 2-PAM is also effective prophylactically. In severe poisonings, artificial respiration (with oxygen if available) may be necessary.

All warm blooded animals, including man, are susceptible to poisoning by this group of compounds. Birds are particularly sensitive; avian species in general show marked signs of demyelinations after exposure to organic phosphorus compounds.

The organic phosphorus, anticholinesterase, insecticides have important use in the control of insect pests; but they are far from harmless chemicals. All warm blooded animals can be poisoned fatally by them. Men who use these agents should wear impervious protective clothing and a gas mask. At the end of each work period they should wash down thoroughly with soap and water. Needless to say all persons who use these agents should have regular tests for level of red blood cell cholinesterase activity.

Finally, brief mention should be made of organic thiocyanates which are often used in combination with pyrethrin as household sprays. They are contact poisons which act on nerve ganglia of insects. Lethane and thamite are trivial names for two of these insecticides. All are toxic to mammals. The lethal dose falls between 0.4 and 2.0 g/kg. In warm blooded animals, the organic thiocyanates paralyze the central nervous system. Signs of acute poisoning include depression, dyspnea, cyanosis and convulsions. Chronic poisoning brings about hyperemia of internal organs with edema and hemorrhage. There is no specific therapy. Treatment, after removal from source of poison, is symptomatic and supportive.

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For those orphan pups; a combination of two raw eggs to 8 oz. of cows milk is recommended. Feed 2 oz. per pound of body wt. per day. It is increased by ⅓ oz. per lb. for the second and third weeks.

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