

# Toxic Hazards from the Use of Insecticides in the Control of *Aedes aegypti*

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At the time of the writing of the present communication, which was before the holding of the seminar upon which this publication is based, it was possible to consider only the general principles that must be taken into account before assessment of the likely hazard to man that will be presented by any particular insecticide when used in a specific manner.

In the present communication, it is assumed that any available and effective insecticide will fall into one of the three following groups: chlorinated hydrocarbon, such as DDT and dieldrin; organophosphorus compounds; and chemosterilants.

It is necessary to consider how the known toxic properties of the chemical might determine the hazard presented both to those who prepare and disperse the insecticide and to those (young and old, sick or healthy) who will be exposed to insecticide residues in their food, water or domestic environment. It is also assumed here that contamination of drinking-water will be an important source of exposure. In any mosquito-eradication programme, very large human populations will be exposed to insecticides, and the occasional hypersensitive person will be encountered. However, experience with their use in other fields indicates that none of the insecticides so far developed has demonstrated an exceptional capacity for sensitizing man.

## CHLORINATED HYDROCARBON COMPOUNDS

On the whole, chlorinated hydrocarbon compounds are quite safe to apply, although long exposure to dieldrin in house spraying can cause acute poisoning. All compounds in this group are very insoluble in water, so that a saturated solution of one of them in water can never be dangerous. At a level of 1 ppm DDT in water, a 50-kg man drinking 2 litres daily would receive a total dose of 0.004 mg/kg/day. According to the report of the second joint meeting of the FAO Committee on Pesticides

in Agriculture and the WHO Expert Committee on Pesticide Residues,<sup>2</sup> the acceptable daily intake for man is 0.01 mg/kg/day, so that there is a wide margin of safety. While this report includes no figure for dieldrin, it is known that the populations of some Pacific islands have consumed dieldrin-saturated water for 7 years without showing any ill effects or accumulating excessive quantities of this compound in their tissue fat.

The occasional consumption of greater amounts in, for example, recently sprayed water, will not be dangerous, but the use of briquettes for slow release should obviate all risk of exceeding the very conservative "acceptable daily intake".

## ORGANOPHOSPHORUS COMPOUNDS

The most toxic of the organophosphorus (O-P) compounds, including parathion, phorate and TEPP, have caused fatal poisoning of persons using them in agriculture. The handling of dry or liquid concentrates can be dangerous, but the most toxic of the O-P compounds can be safely used in the form of granules or as other formulations when applied under proper supervision. The joint FAO/WHO Committee report referred to above has indicated that the acceptable daily intake for parathion is 0.005 mg/kg/day, which means that a solution containing 0.1 ppm can be consumed safely. The much less toxic malathion is given a figure of 0.02 mg/kg/day, only 4 times greater; i.e., 0.4 ppm. While these figures indicate safe intake levels, it is apparent that, with a compound like parathion, the potential hazard through mistreatment or misuse is such that its application in drinking-water in the form of an emulsion or wettable powder concentrate could not be contemplated. While the joint FAO/WHO Committee meeting report gave no figures for the acceptable daily intake of all O-P insecticides, the safety

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<sup>2</sup> FAO Meeting Report No. PL/1965/10; WHO/Food Ad./26.5.

of any particular level in the drinking-water of a population can be assessed readily by studies on the blood cholinesterase activity levels in the population.

It is known that residents in some types of sprayed houses may absorb enough O-P insecticide to cause a measurable depression of cholinesterase, but such persons present no symptoms of poisoning. The O-P compounds, as a class, are rapidly metabolized and excreted from the body. They do not cause structural damage to tissues, and the enzymes they inhibit are readily restored. If these compounds are applied properly, the population should not be at any risk. However, if liquid and powder concentrates are used, the chance of accidental and fatal poisoning will be considerable with parathion and materials of comparable toxicity.

For water treatment, any risks of overdosage can be avoided by using a granular or slow-release preparation. Less toxic O-P compounds can be used for house spraying, etc., though more care is needed with them than with DDT.

#### CARBAMATES

The most widely used insecticides in the carbamate group are in the category of monomethyl carbamates. These are toxic because, like O-P compounds, they inhibit cholinesterase. However, the inhibition of true cholinesterase is very rapidly reversed once the level of carbamate in the tissues has fallen. The rate of recovery of the plasma cholinesterase is much slower, but the significance of a continued depression of this enzyme is uncertain. In carbamate poisoning, it is almost certain that any symptoms of poisoning will appear even with doses very well below a dangerous or lethal level. There is no danger of chronic cumulative poisoning with this type of compound. From the point of view of

safety, both in application and to consumers, the carbamates appear to have many advantages.

#### CHEMOSTERILANTS

Experiments on rats indicate that chemosterilant compounds active against insects act similarly on mammals. The developing sperm in the male rat is affected to very different degrees, depending on the dose. A striking cumulative effect of repeated small doses of these highly reactive compounds poses a problem urgently requiring investigation. The fact that small doses of these chemosterilants can apparently induce genetic changes in rats means that no possible assessment of a "safe dose" or "acceptable daily intake" for man can yet be put forward for any chemosterilant.

#### SUMMARY

For the chlorinated hydrocarbon, O-P and carbamate insecticides, it seems probable that levels in drinking-water that are adequate to control mosquito-breeding need not lead to undesirably high residues for the human consumer. Each proposed use must be considered on its merits and, where possible, the figures of an "acceptable daily intake" put forward by the WHO/FAO Committee should be used as a basis for deciding whether a procedure leading to a measurable contamination of water would be acceptable. For compounds in the O-P or carbamate group for which no such figure exists, investigation of the effect of drinking treated water upon blood cholinesterase activity should be undertaken in pilot-scale trials.

The risk of accidental acute poisoning, such as by excessive treatment or spillage, must be borne in mind when considering the ways in which the active principles are to be distributed.