Short Communication

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Malathion Toxicity and its Stability in Water

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Abstract

Pesticides can improve the quality of agricultural products and provide food security, but they can also have negative effects on the ecosystem. In agriculture, forestry, health, and other industries, pesticides are an essential productivity tool for controlling pests. For the past few decades, pesticides have been utilized in agriculture to manage and eradicate agricultural pests as well as in the public health sector to combat disease vectors. However, during the past 10 years, India has seen a sharp increase in the number of pesticides used in agriculture, which has left the environment extremely polluted and seriously jeopardising human health. Malathion is an organophosphorus pesticide with moderate toxicity. It absorbs through the skin by inhalation and from the gastrointestinal tract. It acts, after metabolic conversation to the oxygen analogue, melaoxon, by cholinesterase inhibition. Continuing exposure may inhibit cholinesterase activity to hazard levels. This study demonstrated that the stability of malathion in water was investigated because it is an agricultural pesticide that may be harmful to the general public's health. A week's worth of malathion concentration was accumulated in water in just one week.

Keywords: Pesticide; Toxicity; Degradation; Malathion.

INTRODUCTION

The initial intent of using pesticides was to steer clear of, control, and get rid of unwanted insects, pests, and related illnesses. But there are now worries about the environment and public health as a result of the rising use of these substances[1] (Bhanti *et al.*, 2007). An organophosphate pesticide called malathion is utilised in veterinary care, agricultural, commercial extermination, fumigation, and home and public health applications. Malathion is one of the most widely used organophosphate chemicals in the US because to its low mammalian toxicity, which makes it one of the main sources of pesticide exposure at work[2] (Bonner *et al.*, 2007).

Malathion, one of the most commonly used organophosphorus pesticides, is among the pollutants that have leaked into fresh water, marine, and subsurface water bodies as a result of pesticide applications and land use close to the water matrix. Drinking tainted water can expose people to malathion, which can have harmful health implications[3] *(Vasseghian et al., 2022)*. The first widespread usage of a broad spectrum insecticide for both agricultural and non-agricultural uses is malathion. It is applied directly to bodies of water to destroy mosquito larvae. According to *Webb and Crain (2006)*, the concentration of malathion in

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real world environments ranges from 0.008–0.012 µg/L in rivers that enter the Chesapeake Bay to up to 0.16 µg/L in urban streams and up to 15 µg/L in Colorado wetland.[4] According to multiple studies, water samples from different locations had extremely high amounts of Malathion (8.12 µg/L to 105.2 µg/L), which posed a serious concern[5] *(Luo et al., 2016).*

Malathion is an organophosphorus insecticide and acaricide with moderate mammalian toxicity and moderate persistence. It is an indirect inhibitor of cholinesterase. Contamination of agricultural water with pesticides is a considerable subject for public health authorities. Malathion is a relatively stable neutral and acidic media. However, in the presence of moisture, this compound decomposes rapidly through hydrolysis. Therefore, it was considered of interest to study the stability of malathion in water. In public health programs, malathion is Used in malaria control as a residual insecticide. It is usually applied as a 5%. suspension of water dispersible powder[6] *(Coffin, 1966).* Also, it is extensively used for the control of mosquito borne viral infections from the ground and air, usually at 500 ml/ha or as a thermal fog using 2-4% solution in diesel oil. As a mosquito larvicide, 2.5% suspension or emulsion of it is used[7] *(Faust et al., 1966).* Also, it was recommended against DDT resistant fleas at 5% dust in the burrows of the rodents[8] *(Casida et al., 1961).* According to a study, there have been losses in amphibians for many years, some of which have been linked to environmental toxins. When Xenopus laevis tadpoles were exposed to malathion for 30 days, the death rate was greater in the 1.0 mg/L malathion group than in the control group.[4]

The study aims to check the relative stability of Malathion in neutral, moderate, and acidic media. However, the compound decomposes rapidly through base induced hydrolysis in the presence of moisture. It was, therefore, considered of interest to study the stability of malathion in an aqueous solution.

MATERIALS AND METHODS

Three sets of water samples were prepared. Each set involved six conical flasks containing 100 ml water. The first set contained preserved water (pH=7.5), the second set, distilled water (pH=6.2), and the third set, slighted alkaline water (pH=7.3). Acetone solution of malathion (1ml; 1%) was added to each of them. To study the stability, one flask from each set was analyzed periodically by thin-layer chromatography (TLC). The samples were analyzed over 3 weeks by Gas Chromatograph for quantification and then confirmed by Gas Chromatograph with Mass Spectrometer (model Ion trap variant made 450GC and 240 MS & CP-8400 autosampler and Quadrupole Agilent made 68990N and 5975 inserts XL) and Liquid Chromatography Mass Spectrometry (HPLC-MS) (Agilent 6410 triple quard LC/MS 1200 RRLC and 410A MS/MS).

The extraction was done with 100, and 50, ml portions of petroleum ether. Each flask vigorously was shaken every time. The combined ether extract was then passed through anhydrous sodium sulfate. The extract evaporated carefully in a water bath and the residue were taken in acetone and subjected to HPTLC (Model-CAMAG).

RESULTS AND DISCUSSION

The concentration of malathion in various compounds is shown in Table 1. The results indicated that malathion concentration was hydrolyzed in a mixed water solution after 3 weeks. The loss is most rapid in tap water, which is basic. The residue level falls to zero within two weeks.

Table 1: Analysis of different time zones of malathion in water.

Analysis time	Amount of malathion (%)		
	Preserved water	Distilled water	Alkaline water
1 hr	100	100	100
4 days	<7	80	25
7 days	<2	71	22
14 days	BDL	68	19
21 days	BDL	46	11

BDL - Below Detection Limit

Compared to parathion, malathion disappears more rapidly in aqueous solution of comparable chemical composition. It has been noticed that malathion is relatively stable in neutral and moderately acidic media. However, in the presence of moisture, the compound decomposes rapidly through base induced hydrolysis. It was, therefore, considered of interest to study the stability of malathion in aqueous solution.

Ethical Considerations: Ethical permission is not applicable.

Conflict of Interest: The authors state no conflict of interest.

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