Research Article

Assessment of Dimethoate Residues from Dal Lake of Jammu and Kashmir, India

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Abstract

Dal Lake is heavily stressed due to the anthropogenic activities around its catchment area which has led to deterioration of its water quality. Among the major sources of contamination are pesticides in and around the lake. Present study was to ascertain the presence of organophosphate pesticide dimethoate in the lake. Liquid-liquid extraction was employed to extract pesticide residues in water samples using methylene chloride and hexane mixture before being analyzed on GC. Water sampling was done with the help of Ruttner's sampler. Among seven different sites selected for water sampling in the lake, three sites (S_1, S_1 and S_3) were found contaminated with dimethoate. The highest concentration of the pesticide was found at bottom of S_3 (0.04567 mg kg^{-1}) followed by bottom of S_2 (0.0213 mg kg^{-1}), column + bottom of S_1 (0.0182 mg kg^{-1}) and column of S_3 (0.01067 mg kg^{-1}). Although the contamination level of the lake is below MRL, yet on account of the indiscriminate use, the pesticide is potent to get bio-accumulated in fishes and economically important plants thereby inducing toxicity to humans as well after being consumed.

Keywords: Contamination, Dal Lake, Dimethoate, MRL, Pesticides, Residues, Toxicity

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Introduction

Massive use of pesticides to control or reduce the disease prevalence in agricultural sector has put negative impacts on aquatic ecosystems. Most of the insecticides ultimately find their way into rivers, lakes and ponds [1-7] through various routes like precipitation, leaching, drift and runoff. In natural waterbodies, the surface water contamination may have ecotoxicological effects for aquatic flora and fauna as well as for human health if used for public consumption [8-11]. Unwanted side effects of even strictly controlled uses of pesticides on non-target aquatic organisms are extremely difficult to avoid [12].

Assessment of pesticide levels and their quantification in natural waterbodies is necessary in order to have an eye on their level of contamination and risks associated with them. Dal Lake, besides its natural endeavours is also known for floating gardens where the locals grow variety of vegetables to make their economy; hence application of pesticides has become imperative for the better growth of their crop. Water of the lake, although deteriorated, is still used for drinking, washing utensils and for other potable purposes by the people residing in the lake or on its banks. However indiscriminate use of pesticides especially dimethoate and other noxious substances are liable to get accumulated in the lake. For this reason present study was undertaken to assess the presence of an organophosphorous compound dimethoate [*O, O*-dimethyl *S*-methylcarbamoylmethyl phosphorodithioate] in the Lake.

Material and Methods

Sample collection

Seven different sampling locations were selected in Dal Lake depending upon deteriorated water quality, extent of pollution and distance from the vegetable grown sites in and around the Lake. They include Goripora Chowk (S_1), Akhoon Mohalla Dal Kutwal (S_2), Akhoon Mohalla Dal Kutwal Chowk (S_3), Chount (Koul) (S_4), Brain Laam (S_5), Peer Bagh Chowk (S_6) and point of entry to Dal through Tailbal (Nalla) rivulet (S_7). Water samples were collected from all the three layers (surface, column and bottom) of different sites of the lake with the help of Ruttner's sampler and subjected to extraction as per the method described by [13]. Water samples from areas with low depth were considered for both column and bottom. 1 litre of water sample was filtered through Whatman's filter paper in 1 litre-separating funnel, partitioned twice with 75 ml methylene chloride and supernatant layer collected. Partitioning with

hexane 75 ml and lower layer collected followed this. All the extracts collected were passed through anhydrous sodium sulphate, which was earlier, washed with methylene chloride followed by hexane. The extracts were concentrated up to dryness in a rotary vacuum evaporator, reconstituted with hexane and kept in refrigerator until analyzed on gas chromatography.

The final extracts were analyzed on Varian 450 Gas Chromatograph (GC) equipped with capillary column CP sil 8CB (25m x 0.25µm df x 0.25 od) and Electron Capture Detector (ECD). The operating parameters of the instrument were: injection port 240 ^{o} C, oven programming of GC consist of 170^{o} C for 2 Minutes, with increase of 6^{o} C/minute up to 230^{o} C, then increase of 10^{o} C up to 260^{o} C and final increase of 10^{o} C min^{-1} up to 270^{o} C with hold time 5 Minutes, and detector 300^{o} C. Nitrogen was used as carrier and makeup gas (1ml min^{-1} and 30 ml min^{-1} respectively). Under these operating conditions the retention time of dimethoate was found to be 8.71 minutes. The total run time of the programme was 31 minutes. The control samples of water were spiked at 0.10 and 0.20 mg kg^{-1} for dimethoate. Following the methodology as described above control samples were processed. The results revealed that percent mean±SD recoveries for chlorpyrifos at 0.10 and 0.20 mg kg^{-1} were 95.4±0.045 and 89.2± 0.056 respectively (**Table 1**).

Table 1 Recovery of dimethoate from water

Chemical	Substrate	Level of fortification (mg kg^{-1})	% Recovery [a] ± SD
Dimethoate	Water	0.10	95.4±0.045
		0.20	89.2±0.056

[a] Average ± SD of three replicates (SD = standard deviation)

Results

Among six sites selected for collection of water samples, three sites viz. Goripora Chowk, Akhoon Mollah Dal Kutwal, and Akhoon Mollah Dal Kutwal Chowk were found contaminated with dimethoate. Highest concentration of the pesticide was found at bottom of Akhoon Mollah Dal Kutwal Chowk with 0.04567±0.00651 mg kg^{-1}, followed by Bottom of Akhoon Mollah Dal Kutwal 0.0213±0.00207 mg kg^{-1}, column and bottom of Goripora Chowk 0.0182±0.00485 mg kg^{-1}, and column of Akhoon Mollah Dal Kutwal Chowk 0.01067±0.00209 mg kg^{-1} (**Table 2**). However no pesticide was detected at other sites viz., Chount (koul) rivulet, Brain Laam and Peer Bagh Chowk analyzed at all the three layers (surface, column and bottom) of the lake.

Table 2 Residues of dimethoate in water of Dal Lake at different depths

Sites of Dal Lake Selected	Layer of Water From which Pesticide Detected	Insecticide Determined	Average residues [a] (mg kg^{-1} ± SD)
Goripora Chowk (S_1)	Column + bottom*	dimethoate	0.0182±0.00485
Akhoon mollah Dal kutwal (S_2)	Bottom	dimethoate	0.0213±0.00207
Akhoon mollah Dal kutwal Chowk (S_3)	Column	dimethoate	0.01067±0.00209
Akhoon mollah Dal kutwal Chowk (S_3)	Bottom	dimethoate	0.04567±0.00651
Chount (koul) rivulet (S_4)	-	-	-
Brain Laam (S_5)	-	-	-
Peer Bagh Chowk (S_6)	-	-	-
point of entry to Dal through Tailbal (Nalla) rivulet (S_7)	-	-	-

*Water samples merged on account of shallowness of the area
[a] Average± SD of three replicates (SD = standard deviation)

Discussion

Aquatic resources are exceptionally valuable natural assets which provide us long-term benefits in return for minimal care and protection. People involved in fishing trade, exploitation and selling of economically important aquatic plants get directly benefitted from the natural waterbodies. The other commercial fishers, wholesalers, retailers and other people also get benefitted indirectly from the aquatic ecosystems through various means such as consuming of fishes and edible aquatic plants and recreational or aesthetic purposes. Appreciation of fisheries and aquatic systems has been accompanied by increasing concern about the effects of growing human populations and human activities on aquatic life and water quality. Pesticides are beneficial chemicals, instrumental in controlling many insect pests, protect farm crop losses and aid in efficient food production. However their toxic behaviour is can have profound effects on aquatic life and water quality. On entering the aquatic ecosystems**,** the pesticides cause toxicity to aquatic

organisms leading to detrimental effects in them. The intoxicated organisms especially fishes, which are subsequently consumed by human beings, can prove harmful to them as well. During the present investigation, the dimethoate residues found in the Dal Lake are indicative of threat that the natural waterbodies of Kashmir valley have started getting contaminated with pesticides residues. Our findings were in accordance with the results of [14] who studied contamination of fresh water fish, *Schizothorax niger* with chlorpyrifos from Dal Lake basins and reported the pesticide continuously for three years. It is important to have an eye on distribution pattern of these pesticides in the environment because they do not remain at their target site but often enter aquatic environment via soil percolation, air drift or surface runoff affecting abundance and diversity of non-target species producing complex effect on the ecosystems and altering tropics interactions [15].

Conclusion

The study conducted revealed the presence of organophosphate pesticide dimethoate in the lake which can pose threat not only to the use of Dal waters for human consumption but also to the commercially important plants and animals as well. Therefore measures need to be taken to restrict the entry of toxic compounds like dimethoate in the lake.

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