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Pesticides pollution in water, sediment and Fishes of Kolavai Lake in Chengalpet, Tamil Nadu, India.

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Abstract: The qualitative Pesticides risk assessment of Kolavai Lake water,Sediment and three fish samples have been carriedout in various seasons. The pesticides analysis revealed that the water and the sediment were not possess the DDT,Aldrin,Endrin, Carbofuran and Malathion. The pesticides analysis in fishes revealed that the two fish Oreochromis mossambicusand Labeo rohita muscle tissues were not possess DDT, Aldrin, Endrin, Carbofuran and Malathion. But the bottom feeder Cirrhinus mrigala alone was found with the chloro phyri phos in the range from 37ppb to 72ppb. The highest value (72ppb) was observed in monsoon and the lowest value (37ppb) was observed in summer. The bottom feeder (Mrigal) alone polluted with Choloro phyri phos .
Key words: Kolavai Lake, Oreochromis mossambicus,,Labeo rohita, Cirrhinus mrigala, DDT, Aldrin, Endrin, Carbofuran and Malathion.

Introduction

Today the pesticides are present throughout the ecosystem. Measurable amounts of DDT residues can be found in the air, soil and water thousands of Kilo meters from where it was applied originally. Being long lasting under natural conditions they cannot easily be degraded by micro organisms and physical forces in the environment. Their concentration, therefore, goes on increasing in soil and water with successive applications. Which accumulate a very high concentration in the body fat. On fat breakdown during respiration it is released in the blood stream and may cause toxic effects.

Materials and Methods:

Samples were collected directly in pre-cleaned plastic sample bottles. Care was taken not to disturb the surface of the soil layer while collecting the samples. The water samples were not filtered to separate suspended particles because the suspended particles, especially fat particles, could contain POPs in them. Samples were kept below 4^{o}C until analysis. The pesticide standards were purchased from Sigma-Aldrich with the purity of 99.8%. All other chemicals, solvents and reagents used in this study were of analytical grade.500 ml of each water sample was taken in a separating funnel and 50g of sodium chloride was added. The content was extracted three times with 50 ml of n-hexane. 30 g of anhydrous sodium sulphate was added to the combined extracts. The extracts were filtered and the water-free organic layer was taken in an evaporation flask. The volume was carefully reduced to about 0.5 – 1.0 ml by evaporation, never allowing the temperature to exceed

69°C. The sample was cleaned up with 2 ml of 95 - 97% pure sulphuric acid saturated with cyclo hexane. The mixture was left for separation and the upper phase was taken for analysis in a gas chromatograph.

Weigh in to blender jar amount estimated (25-50 gm) to provide 3g of fat in separate container mix. The amount of sodium sulphate equal to 2.5g x estimated weight of water in sample with 100 ml petroleum ether and transfer to blender jar. Mix at medium speed for 3 min. Allow solids to settle and decant petroleum ether through medium porosity filter paper in to tared 500ml. Erlenmeyer flask to which a few boiling chips had been added before weighing. Add 100ml petroleum ether to residue in blender jar. Mix at medium speed for 1 min. Allow solids to settle and decant petroleum ether through filter to combine with above filtrate. Transfer solid residue in blender jar to filter paper. Fold paper over solids, and squeeze paper gently against side of funnel with spatula to recover as much solvent as possible. Evaporate petroleum ether on water bath. Dry flask and weigh flask plus contents. Determine amount of fat by subtracting tare weight of flask.

Determine the percent fat in food from the weight of the extracted fat. Weigh 3gm of fat in to a 125ml separator and add petroleum ether. So that the total volume of fat and petroleum ether is 15ml. Add 30ml of aceto nitrile saturated with petroleum ether. Shake vigorously 1 min. Allow the layers to separate and drain the aceto nitrile in to 1 L separator containing 650 ml water,40 ml saturated salt solution and 100ml of petroleum ether. Extract the remaining petroleum ether in the 125 ml separator with 3 additional 30 ml portions of aceto nitrile saturated with petroleum ether, shaking vigorously 1 minute each time. Combine all the extracts in the 1L separator.

Hold the 1L separator in a horizontal position and mix thoroughly 30-45 seconds. Let the layers separate and drain the aqueous phase in to second 1L separator. Add 100ml of petroleum ether to the second separator shake vigorously 15 seconds and let the layers separate. Discard the aqueous phase, combine the petroleum ether with that in the first separator and wash with two 100ml portions of water. Discard the washings and draw off the petroleum ether layer through a 50mm column of anhydrous sodium sulphate in to a 500 ml K-D concentrator. Rinse the separator and then the column with three approximately 10 ml portions of petroleum ether. Evaporate the combined extract and washings to about 5 ml.

Prepare a column of Florisil 10cm high (after settling) and topped with about 1 cm of anhydrous sodium sulphate. Wet the column with 40-50 ml of petroleum ether. Place the K-D evaporator (with a graduated collection tube under the column) to receive the eluate. Transfer the petroleum ether concentrate to the column and let it pass through at 5 ml/minute .Rinse containers with two approximately 5 ml portions of petroleum ether, pour the rinsing on to the column, rinse the walls of the tube with Concentrate each eluate to a suitable definite volume in the K-D concentrators. The 6 % eluate contains chlorinated pesticides such as Aldrin, HCH, DDE, DDD, O,P'- and P.P'- DDT, Heptachlor, Heptachlor Epoxide, Lindane, Methoxychlor, Mirex and Perthane and industrial chemicals such as poly chlorinated biphenyls. If further clean up is necessary, repeat the Florisil clean up using a new column. The 15%eluate contains the chlorinated pesticides Dieldrin and Endrin. In those cases where the 15% eluate must be further cleaned, destruction of fatty material can be accomplished by saponification, as follows.

Transfer the concentrated eluate to a 125 ml glass-stoppered flask, rinsing with petroleum ether and evaporated just to dryness. Add 20 ml of 2% ethanolic sodium hydroxide and reflux 30 minutes under an air condenser. Transfer to a 125 ml separator and rinse the flask with three 10 ml portions of petroleum ether, transferring each to the separator. Add 20 ml of water and shake vigorously. Drain the aqueous layer in to a second separator containing 20 ml of petroleum ether shake vigorously, allow separating, discarding the aqueous layer and adding petroleum ether to the rust separator. Wash the combined petroleum ether extracts with three 20 ml portions of aqueous ethanol (1+1). (If the initial aqueous alcohol wash causes heavy emulsions, use water only for additional washes).Discard the wash dry the petroleum ether layer through the 50 mm column of anhydrous sodium sulphate rinsing with petroleum ether. Concentrate the solution using a K-D concentrator, to suitable volume (2-4ml) for gas chromatography.

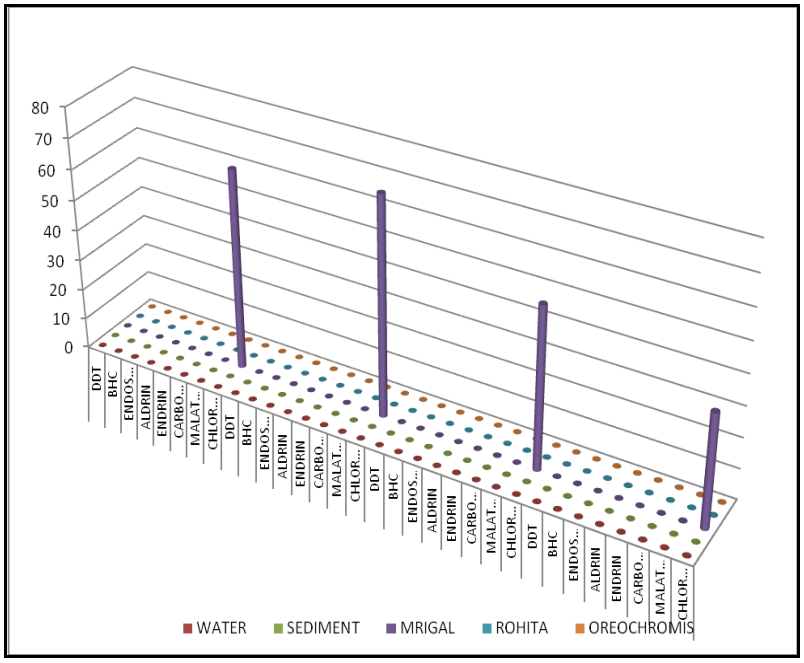
Inject 5µl of the final cleaned extract in to the gas chromatograph and compare to known standards.

Calculations

Mg sample / µl injected = (w) / (V) (%)

Where
W = g fat taken for analysis
V = ml of final solution
% = percent fat in the sample expressed as a decimal
(i.e; 12% fat-0.12)

HPLC is used to find out the pesticides present in the fish muscle tissue samples. The results were tabulated in parts per billion.



Pesticides level in different samples.

Table 1 - Pesticides in Kolavai Lake- (ppb) in parts per Billion

	Pesticides	Water	Sediment	Mrigal	Rohita	Oreo Chromis
	DDT	BDL	BDL	BDL	BDL	BDL
	BHC	BDL	BDL	BDL	BDL	BDL
	ENDOSULPHAN	BDL	BDL	BDL	BDL	BDL
	ALDRIN	BDL	BDL	BDL	BDL	BDL
PRE MONSOON	ENDRIN	BDL	BDL	BDL	BDL	BDL
	CARBOFURAN	BDL	BDL	BDL	BDL	BDL
	MALATHION	BDL	BDL	BDL	BDL	BDL
	CHLOROPHYRIPHOS	**BDL**	**BDL**	**66**	**BDL**	**BDL**
	DDT	BDL	BDL	BDL	BDL	BDL
	BHC	BDL	BDL	BDL	BDL	BDL
	ENDOSULPHAN	BDL	BDL	BDL	BDL	BDL
	ALDRIN	BDL	BDL	BDL	BDL	BDL
MONSOON	ENDRIN	BDL	BDL	BDL	BDL	BDL
	CARBOFURAN	BDL	BDL	BDL	BDL	BDL
	MALATHION	BDL	BDL	BDL	BDL	BDL
	CHLOROPHYRIPHOS	**BDL**	**BDL**	**72**	**BDL**	**BDL**
	DDT	BDL	BDL	BDL	BDL	BDL
	BHC	BDL	BDL	BDL	BDL	BDL
	ENDOSULPHAN	BDL	BDL	BDL	BDL	BDL
	ALDRIN	BDL	BDL	BDL	BDL	BDL

POST MONSOON	ENDRIN	BDL	BDL	BDL	BDL	BDL
	CARBOFURAN	BDL	BDL	BDL	BDL	BDL
	MALATHION	BDL	BDL	BDL	BDL	BDL
	CHLOROPHYRIPHOS	**BDL**	**BDL**	**53**	**BDL**	**BDL**
	DDT	BDL	BDL	BDL	BDL	BDL
	BHC	BDL	BDL	BDL	BDL	BDL
	ENDOSULPHAN	BDL	BDL	BDL	BDL	BDL
	ALDRIN	BDL	BDL	BDL	BDL	BDL
SUMMER	ENDRIN	BDL	BDL	BDL	BDL	BDL
	CARBOFURAN	BDL	BDL	BDL	BDL	BDL
	MALATHION	BDL	BDL	BDL	BDL	BDL
	CHLOROPHYRIPHOS	**BDL**	**BDL**	**37**	**BDL**	**BDL**

Results and Discussion

Yalavarthi (6) observed the physico-chemical parameters and zooplankton composition in Red hills reservoir of North Chennai in Tamil Nadu during the monsoon from 1997 to 1999. On the basis of this study this reservoir is categorized as soft and mesotrophic nature. Rao and Pillala (5) investigated the concentration of pesticides in sediments from Kolleru Lake, Andhra Pradesh.

Chemical risk assessment of the whole range of fresh water aqua culture fish from Kolavai Lake never been studied in Chengalpet. The objective of the present study was to assess the level of pesticides pollution in fresh water aqua culture fish and water in main production Districts of Kancheepuram. Zafar (7) investigated the Limnology of Hussainsagar Lake, Hyderabad.

The pesticides analysis revealed that the water and the sediment were not found to possess the DDT, Aldrin, Endrin, Carbofuran and Malathion. (Table1).

The pesticides analysis in fishes revealed that the fish muscle tissues were not found to possess the DDT, Aldrin, Endrin, Carbofuran and Malathion. But the bottom feeder *C. mrigala* alone was found to possess the chlorophyriphos in the range from 37 to 72ppb. The highest value (72ppb) was observed in monsoon and the lowest value (37ppb) was observed in summer.

The bottom feeder (Mrigal) alone polluted with Cholorophyriphos because of the agricultural pesticides that entered from nearby fields. Whereas, DDT, BHC are not used by the farmer from long back. Thus it may be the reason for their non availability in fishes.

Persistence of pesticides in water, sediment and fish farms in Kolleru Lake, India, by (4). In Kolleru Lake the result indicated that the pesticides concentration in fish farm decrease in order as water<fish<sediment (5). The maximum value was found in fish farms 1 and 5-8. This may be due to intensive use of pesticides in these farms.

Hasan et al. (1) in his Bangladesh study revealed that poultry, fish, vegetables, lake water were polluted by the pesticides DDT found in the level 121.793µg/l.

Pollution of an aquatic system occurs by many ways such as organic and inorganic chemicals, oils, detergents, radioactive elements and pesticides. However, the magnitude of pesticide pollution should be much greater than that of non-pesticide pollutants, because of the extensive manufacture and applications of these chemical compounds in recent times. The future estimates on estimates on pesticides for purposes of public health will be about 8000 tons for BHC (2). The pesticides normally used for plant protection and for destroying vector borne diseases are categorised in to three major groups based on the reactive groups present in the original molecule as Organochlorides (OC), Organophosphates (OP) and Carbamates.

Organochlorides

They are persistent pesticides such as DDT, BHC, Endosulphan, Aldrin, Dieldrin, Endrin being readily soluble in fats, in fat deposits of human and other animals. The rapid elimination of OC residues in tissues is not possible, since they are not metabolised enough in the body. These compounds are known to undergo biological

magnification and accumulate in the ecosystem. These pesticides could interfere with nerve impulse transmission through neurons and synopsis by way of altering ionic movements.

Carbamate pesticides

The carbamate pesticides like carbaryl, carbofuran, aldicarp etc. are relatively more soluble in water. In most cases, when ingested they are rapidly excreted. Normally they do not accumulate in tissues. They possess anti cholinesterase activity and were known to produce behavioural change. These insecticides are found to inhibit the action of AChE in insects.

Organophosphorus pesticides

They are toxic compounds having a phosphorus atom. The first OP compound to be synthesised is Tetra ethyl pyrophosphate followed by Parathion, Malathion and others. These are found to inhibit esterases in living systems and AChE in synaptic nerve transmission.

The concentration of various pesticides in the Kolavai Lake sediment and in fishes was found at below the detectable levels (BDL) except the pesticide the chloro pyro phos. But it was observed below the WHO Guide lines limits. It was found higher in monsoon season. This pesticide contamination in the lake may be due to the use of this pesticide in nearby agricultural fields and also indirectly by influx water. It may create various effects like mass mortality, changes in behaviour, low survival rate and morphological and physiological changes in the organ system of fishes. It may lead in cough, cold, bronchitis, cancer in skin, eye, and kidney and in prostrate glands in Human. According to WHO, the maximum permissible limits of DDT in water is 0.2µg/L, and for the aldrin and eldrin is 0.05µg/L. The pesticide chloro pyri phos was observed in fishes at meagre level. This situation suggests that there is a very low risk of pesticide residue in fish which are sold at markets and this small amount of pesticide residue exist in fish may be totally dissolved by the time they arrive at markets or by cooking process.

With the gradual development of industry, intensive use of pesticides and discharge of untreated domestic sewage may further exacerbate the situation in coming years. So careful monitoring is essential to prevent the pesticide pollution at this movement.

Conclusion

From the study, it is very clear that the water of Kolavai Lake is moderately polluted, because the Fish muscle tissue samples were also found contaminated with chloro pyri phos pesticide. It is revealed that the factors responsible for the water quality degradation of this lake were mainly due to the anthropological activities, contaminated water from the commercial establishments and private and Government hospital wastes. So the water is not suitable for drinking of both human and cattle. The water, Sediment and fishes are not safe for human health and eco system. Gradual development of industries, intensive use of pesticides and untreated domestic sewage may further exacerbate the situation in coming years.

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