

**ORGANOCHLORINE PESTICIDES
IN SEDIMENTS AND FISH
(*Arius maculatus* AND *Clarias batrachus*)
AT THE PAKA RIVER, DUNGUN, TERENGGANU**

AZLINA MAT SAAD

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LIST OF ABBREVIATIONS

Abbreviation	Defifnition
α	Alpha
β	Beta
δ	Delta
γ	Gamma
<	Less than
>	More than
$^{\circ}\text{C}$	Degree celsius
%	Percent
μg	Microgram
$\mu\text{g/ml}$	Microgram/ Millilitre
μm	Micrometer
ATSDR Registry	Agency of Toxic Substances and Disease
BDL	Below detection limit
BHC	Benzenehexachloride
DBOFB	4,4'- dibromooctafluorobiphenyl
DCM	Dichloromethane
DDA	di(<i>p</i> -chlorophenyl)acetic acid
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
g	gram
GC- ECD	Gas chromatography - electron capture detector
GPS	Global positioning system
H_2O_2	Hydrogen peroxide
HCH	Hexachlorocyclohexane
IC	Inorganic carbon
IS	Internal standard
$\text{K}_2\text{Cr}_2\text{O}_7$	Potassium dichromate
kg	Kilogram
km	Kilometre
Kow	Octanol–water partition coefficient
l	Litre
LOD	Limit of detection
m	Metre
MCPA	Malaysian Croplife & Public Health Association
mg/l	Milligram/litre
ml	Millilitre
mm	Millimetre
mS/cm	Millisiemens/centimetre
NA	Not available
Na_2SO_4	Natrium sulfat
ng	Nanogram
OCPs	Organochlorine pesticides
PCB	Polychlorinated biphenyl
POPs	Persistent organic pollutants

ppm	Parts per million
ST	Station
TC	Total carbon
TCMX	Tetrachloro-m-xylene
TOC	Total Organic Carbon
UNEP	United Nations Environment Program
US EPA	United States Environmental Protection Agency
US FDA	United States Food and Drug Administration
WHO	World Health Organization

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Chairperson : Associate Professor Mohamed Kamil Abdul
Rashid, Ph.D
Main Supervisor : Professor Norhayati Mohd Tahir, Ph.D
Faculty : Maritime Studies and Marine Science

High concentrations of organochlorine pesticides (OCPs) have been a major environmental issue. Therefore, the objectives of this study are to determine the concentrations and distributions of OCPs in sediments and fish, together with their relationships at Paka River and Lembah Sitrus, Durian Mentangau, both in Terengganu, Malaysia. The OCPs groups namely DDTs, BHCs and cyclodienes were investigated in sediment (surface) and muscle tissue (flesh) of fish (*Arius maculatus* and *Clarias batrachus*) samples at twelve sampling stations in two different seasons.

During inter monsoon season, the concentrations of DDTs group in sediments ranged from >0.51 to 5.45 ng/g dry wt. but not detected in all fish samples. For BHCs group, the concentrations in sediments and fish ranged from >1.62 to 195.60 ng/g dry wt. and from >0.90 to 395.43 ng/g dry wt., respectively. For cyclodienes group, sediment samples recorded a range of >0.43 to 303.83 ng/g dry wt. and fish

samples were recorded with a range of >0.50 to 126.04 ng/g dry wt. However, different results have been reported during monsoon season. The concentrations of DDTs group in sediments and fish during monsoon ranged from >0.51 to 3.13 ng/g dry wt. and from >0.52 to 2.60 ng/g dry wt., respectively. For BHCs group, concentrations of >1.62 to 663.44 ng/g dry wt. in sediment samples and >0.90 to 506.85 ng/g dry wt. in fish samples, were recorded. At the same time, the concentrations of cyclodienes group in sediments and fish during the monsoon sampling ranged between >0.43 to 223.42 ng/g dry wt. and >0.50 to 149.40 ng/g dry wt., respectively.

In general, different levels of distributions for different groups of OCPs have been recorded at the sampling stations. DDTs group was dominated by 4,4'-DDE, BHCs group by β -BHC while cyclodienes group by aldrin and heptachlor epoxide compounds. For relationships between sediment and fish samples, there was a moderate, positive correlation between DDTs in sediments and DDTs in fish ($r=0.59$) for monsoon sampling. For BHCs group, there was no correlation, since the r value was closed to zero during inter monsoon season and a very weak, positive correlation ($r=0.27$) during monsoon season. For cyclodienes group, both seasons demonstrated very weak negative correlations between fish and sediment samples.

Abstrak tesis yang dikemukakan kepada
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**PESTISID ORGANOKLORIN DALAM SEDIMEN DAN IKAN
(*Arius maculatus* dan *Clarias batrachus*) DI SUNGAI PAKA,
DUNGUN, TERENGGANU**

AZLINA MAT SAAD

Jun 2013

**Pengerusi : Profesor Madya Mohamed Kamil Abdul
Rashid, Ph.D**
Penyelia Utama : Profesor Norhayati Mohd Tahir, Ph.D
Fakulti : Pengajian Maritim dan Sains Marin

Kepekatan pestisid organoklorin yang tinggi telah menjadi isu persekitaran yang utama. Untuk itu, objektif kajian ini adalah untuk melihat kepekatan dan taburan pestisid organoklorin yang terkandung dalam sedimen dan ikan, serta hubungkait di antara kedua-duanya di Sungai Paka dan Lembah Sitrus, Durian Mentangau, di Terengganu, Malaysia. Pestisid organoklorin yang terdiri dari kumpulan DDT, BHC dan siklodiena telah dikaji dalam sedimen dan tisu otot ikan (*Arius maculatus* dan *Clarias batrachus*) di dua belas stesen persampelan dalam dua musim yang berbeza.

Semasa musim perantaraan monsun, kepekatan kumpulan DDT dalam sedimen adalah ber julat dari >0.51 ke 5.45 ng/g berat kering tetapi tidak dikesan dalam semua sampel ikan. Untuk kumpulan BHC, kepekatan dalam sedimen dan ikan adalah ber julat dari >1.62 ke 195.60 ng/g berat kering dan dari >0.90 ke 395.43 ng/g berat kering. Untuk kumpulan siklodiena, sampel sedimen merekodkan julat >0.43 ke 303.83 ng/g berat kering dan sampel ikan direkodkan

dengan julat >0.50 ke 126.04 ng/g berat kering. Bagaimanapun, keputusan yang berbeza telah direkodkan semasa musim monsun. Kepekatan kumpulan DDT dalam sedimen dan ikan semasa monsun ber julat dari >0.51 ke 3.13 ng/g berat kering dan dari >0.52 ke 2.60 ng/g berat kering. Untuk kumpulan BHC, kepekatan dalam sedimen adalah dari >1.62 ke 663.44 ng/g berat kering dan dalam ikan adalah dari >0.90 ke 506.85 ng/g berat kering, telah direkodkan. Pada masa yang sama, kepekatan kumpulan siklodiena dalam sedimen dan ikan semasa persampelan monsun ber julat di antara >0.43 ke 223.42 ng/g berat kering dan >0.50 ke 149.40 ng/g berat kering.

Secara umumnya, terdapat perbezaan taburan untuk setiap kumpulan pestisid organoklorin. Kumpulan DDT didominasi oleh 4,4'-DDE, kumpulan BHC didominasi oleh β -BHC manakala kumpulan siklodiena didominasi oleh sebatian aldrin dan heptaklor epoksida. Untuk hubungan di antara sampel sedimen dan ikan, hubungan positif sederhana telah dicatatkan antara kumpulan DDT dalam sedimen dan kumpulan DDT dalam ikan ($r=0.59$) semasa persampelan pada musim monsun. Tiada korelasi dicatatkan untuk kumpulan BHC pada musim perantaraan monsun disebabkan nilai r adalah menghampiri sifar dan terdapat hubungan positif yang sangat lemah ($r=0.27$) semasa musim monsun. Untuk kumpulan siklodiena, hubungan negatif yang sangat lemah antara sampel sedimen dan ikan dalam kedua-dua musim telah dicatatkan.