

*Selecting Bio-Indicator Fish for Monitoring Organochlorine Pesticide Contamination
in the River*

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Abstract

The aim of this study was to select the appropriate bio-indicator to monitor organochlorine contamination in the river and understand the effecting factors. Two species of fish; spot barb (*Puntius bimaculatus*) and naked catfish (*Bagaridge*) were selected as the representatives of planktonivorous fish and omnivorous fish, respectively, because they were found across the country and can bear to organochlorine pesticide. Fish sample was collected from the rivers in the area of Water Resource Development Program, Sakon Naknon province, Thailand. These rivers received organochlorine pesticide from surrounding agricultural area. The results indicated that organochlorine concentration which accumulated in Spot barb was higher than that in Naked catfish. This finding positively correlated to the higher amount of lipid tissue which found in Spot barb. The possible explanation was organochlorine pesticide which is hydrophobic substance tended to accumulate in lipid tissue. In conclusion, Spot barb can be used as a useful bio-indicator for monitoring organochlorine contamination.

Keywords; organochlorine pesticides (OCPs), bio-indicator, spot barb (*Puntius bimaculatus*) and naked catfish (*Bagaridge*)

Introduction

Organochlorine pesticides (OCPs) are agro-chemical which is widely used in developing countries; including Thailand, for controlling and eliminating pests or insects in farm land. Their high hydrophobic and lipophilic characteristic results in persist and long-term accumulate in the environment not only in abiotic part (Guo et al, 2008 ; Guo, 2008 and Carro, 2004) but also in the biotic. The residue of pesticides used in agriculture finds its way to ponds, streams, and rivers. After being assimilated into the aquatic organisms, they can be passed and biomagnified through the food chain causing adverse effect on ecosystem and human health. Monitoring program for OCPs contamination requires the appropriate “sentinel” to precisely detect them. That sentinel must be widely found in contaminated area and tolerate to the pesticide. From literature reviews, it was found that spot barb (*Puntius bimaculatus*) and naked catfish (*Bagaridge*) which is local fish and widely found across Thailand having the potential to meet that requirement.

However, assimilation and accumulation of OCPs in these fishes are influenced by a number of factors; both internal and external, such as metabolic rate which depends on its species, percentage of lipid content, and season. Thus, the influences of these factors have to be studied for further improve the monitoring program efficiency.

The aim of this study was to understand the effect of species, percentage of lipid content and season on OCPs accumulation in spot barb and naked catfish and identify the appropriate bio-indicator to monitor its contamination in the river.

Materials and Methods

In this study, the representatives of planktonivorous fish (lower trophic level) and omnivorous fish (higher trophic level) were spot barb (*Puntius bimaculatus*) and naked catfish (*Bagaridge*), respectively. They were found across Thailand and could bear to OCPs. Fish samples were collected from the rivers in the area of Water Resource Development Program, Sakon Nakhon province, located in Northeastern Thailand. Nine stations collecting sample was located along the river which receives OCPs from surrounding farm land. The samples were taken in both dry and wet season. Their size ranged from 15 to 20 cm and weight was about 50 g. After collection, their flesh was taken, freeze-dried for 3 days, and then ground into fine powders. Next, dried flesh powders were kept in desiccator until extraction.

Soxhlet Extraction

Soxhlet extraction method was modified from Guo (2008). In brief, dried flesh powders were put in an extraction thimble. Then, the thimble was inserted into Soxhlet extractor filled with 150 ml solvent mixture of n-hexane – acetone (4:1, v/v). Extraction process was run continuously for 7 hours and temperature was kept at 50 °C. The remaining extract was concentrated to 6 ml by using rotary evaporator. Finally, the solution was kept at 4 °C until analysis.

Lipid content

Lipid content measurement was performed by the method modified form Oh (2000). Two milliliters of concentrated solution was dried for about 2 h at 60 °C. Lipid content was calculated following the equation:

$$\% \text{ Lipid} = \frac{(W_2 - W_1) \times FV}{10SW}$$

where, W_1 is the weight of aluminum foil cup (g), W_2 the weight of aluminum foil cup and lipid content after dried (g), FV is solvent volume after extracted (ml), and SW is sample weight (g)

OCPs measurement

Four milliliters of concentrated solution was purified by using florisil as described in Hyung (2000). Briefly, the concentrated solution was applied to the head of florisil packed column. The first fraction was eluted with 150 ml of dichloromethane/hexane (1/4 v/v) and discarded. The second fraction was eluted with 70 ml of hexane and retained. The extract was concentrated to 4 ml. Next, the extract was applied into HPLC cleanup column, and then concentrated to 1ml. Finally, surrogate standard (4,4'-Dibromo-octafluorobiphenyl, DBOFB) was spiked before instrumental analysis by using Gas Chromatography, GC.

Results and Discussions

After percentage of lipid content and OCPs concentration in both fish species was measured, the results indicated that OCPs concentration in spot barb (planktonivorous fish in lower trophic level) was higher than that in naked catfish (omnivorous fish in higher trophic level) as shown in fig 1. The higher OCPs concentration found in spot barb was positive significant correlation with its higher lipid content as compared with naked catfish (Fig 2).

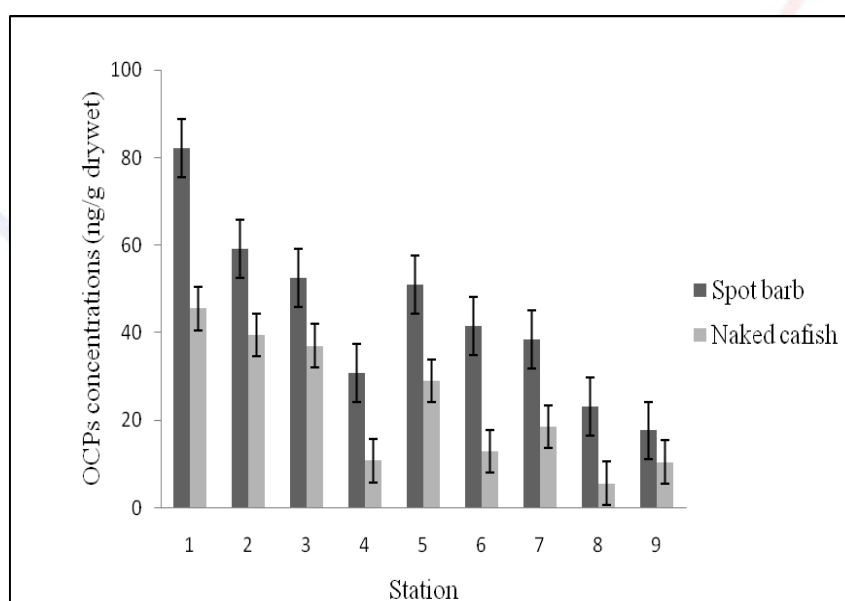


Figure 1 OCPs concentration in spot barb and naked catfish

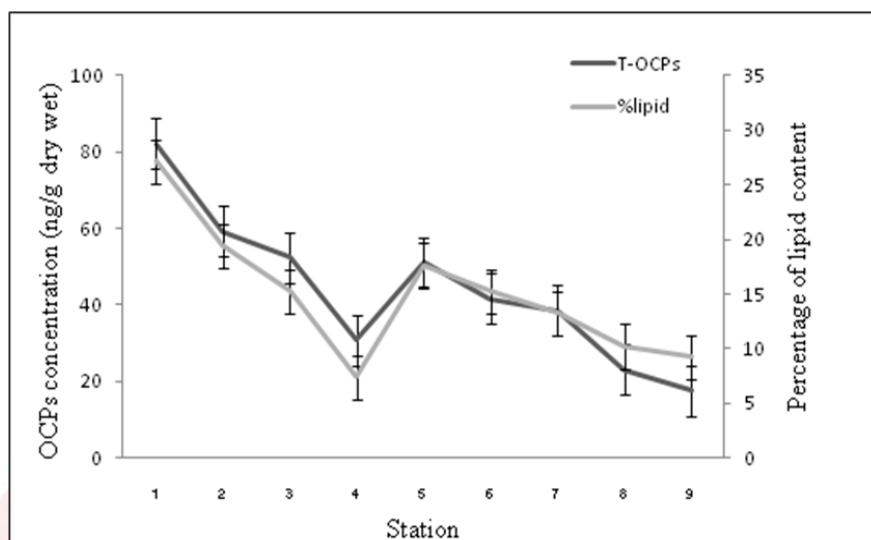
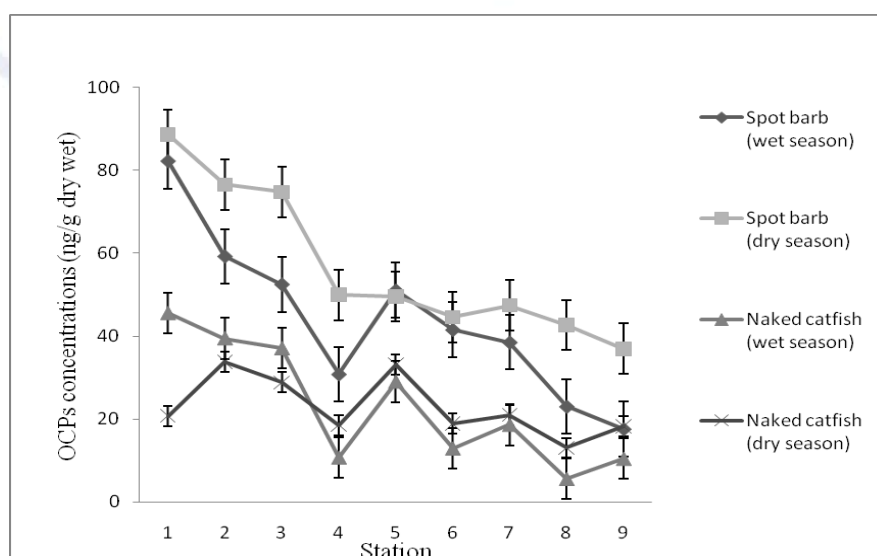


Figure 2 OCPs concentration and lipid content in spot barb

As generally known, hydrophobic contaminant was increasingly biomagnified when passing through food chain. However, the results indicated that OCPs concentration in spot barb which is in lower trophic level was higher than that in naked catfish in the upper level. This phenomenon might be explained by the characteristic of OCPs which is hydrophobic substance thus they tended to accumulate in lipid tissue (bioaccumulation) which found higher in spot barb as compared with naked catfish. This finding was in agreement with the study of Guo et al.(2008) which compare the effect of biomagnification and bioaccumulation by using $\delta^{15} \text{N}$ isotope to assess biomagnification of hydrophobic organic compound passed from prey organisms to the predator and found that the influence of higher lipid content in planktonivorous fish (bioaccumulation) overwhelmed the effect of biomagnification in carnivorous fish in the upper trophic level. This explanation was also supported by the study of Das et al. (2002) which measured OCPs residual concentration in catfish, *Tachysurus thalassinus*, from the South Patches of the Bay of Bengal. They found a positive correlation and linear relationship between OCPs and lipid content in fish.

After comparing OCPs concentration in fish samples collected in dry and wet season, the results indicated that OCPs concentration in both fish species collected in dry season was higher than that in wet season (Fig 3).



This finding might be explained by the characteristic of water channel in dry season. Except lack of water input, the water in dry season is stagnant causing the contaminants to settle down or adsorb onto organic matter and then being feed by the fish. The result was in agreement with the study of Das et al. (2002) which found hydrophobic pesticide residual in fish collected in dry season higher than that in wet season.

Conclusion

Based on the results achieved, difference of species, percentage of lipid content and seasonal variation had influence on OCPs accumulation in the fish. Pesticide accumulation in planktonivorous fish (spot barb, *Puntius bimaculatus*) was higher than that in omnivorous fish (naked catfish, *Bagaridge*) because its higher lipid content in which OCPs tend to accumulate. For seasonal variation, it was found that OCPs concentration in fish collected in dry season was higher than that in the wet season because the aquatic contaminant quite concentrated in dry season. Thus, spot barb (*Puntius bimaculatus*) can be used as a potential bio-indicator fish for monitoring OCPs contamination in the river especially in dry season.

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