Evaluation of river water quality using larval medaka (Oryzias latipes) acute toxicity assay combined with Passive Sampling

山口大学	非会員	**Ashraf Elsheikh**
山口大学	非会員	**Jun Terasaki**
山口大学	正会員	**Masahiko Sekine**
山口大学	正会員	**Ariyo Kanno**
山口大学	正会員	**Koichi Yamamoto**
山口大学	正会員	**Tsuyoshi Imai**
山口大学	正会員	**Takaya Higuchi**

1. Introduction

In recent years, presence of trace chemicals as pesticides, pharmaceuticals and personal care products (point and nonpoint sources) in the aquatic environment has been referred as one of the most urgent environmental concerns[1]. Most aquatic monitoring programs rely on collecting grab, spot or bottle samples of water at a given time. There are drawbacks to this approach in environments where contaminant concentrations vary over time, and episodic pollution events can be missed. Alternatives have been discussed to overcome these drawbacks. Of these, passive sampling methods have shown much promise as tools for measuring aqueous concentrations of a wide range of pollutants[2]. In this study, we investigate the suitability of passive sampling as a substitute of active sampling we have employed in our acute toxicity assay.

2. Methodology

2.1 Disk Selection

There are three passive sampler disks, SDB-RPS, SDB-XC, SDB-XD, which have the similar chemical characteristics (styrene-divinyl benzene copolymer) with Sep-Pak Plus PS-2 cartridges which have been used in previous studies. We conduct a field experiment to select the most suitable PS disks among them, which will achieve the highest adsorption efficiency comparing to active sampling using Sep-pack Plus PS-2 cartridges. Sampling point was M4 from Myojin river in Japan which was exposed mainly to discharged waste water from residential area. At this sampling point, SDB-XC, SDB-XD and SDB-RPS disks were deployed for 24 hours, in addition to 10 liters composite sample which have been collected every 2 hours along the deployment time then filtered through Sep-pack Plus PS-2 cartridges. Adsorbed pollutants had been eluted from both PS disks and Sep-pack Plus PS-2 cartridges then analyzed by GC/MS.

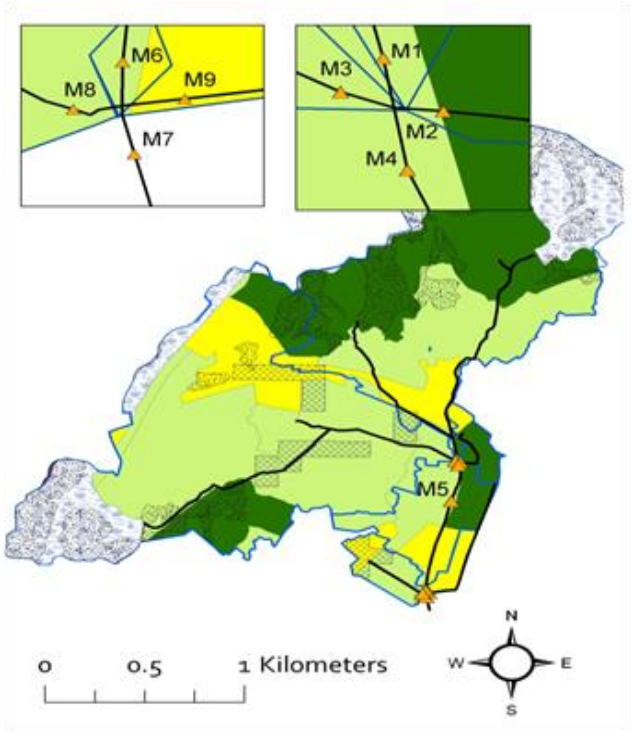

Fig. 1 Sampling point from Myojin river.

2.2 Adsorption amount and rate

Triclosan is a toxic chemical which has been detected in river water in previous studies. So we prepared it at concentrations of 0.2μg/L, which is close to the concentration in a river, 5μg/L, and 10μg/L. For PS, we used one disk for each glass container of 5L triclosan solution. Deployment periods were 1, 2, 3, 7 and14 days, triclosan solution was changed every 24 hours and stirred using a magnetic stirrer at 242.5rpm to maintain a constant concentration. For AS, 5L

triclosan 5μg/L solution was stirred for 24 hours then passed through Sep-Pak Plus PS-2 cartridges. Adsorbed triclosan had been eluted from both SDB-RPS disks and Sep-pack Plus PS-2 cartridges then analyzed by GC/MS.

Table 1: Comparison between GC/MS Results for both PS disks and Sep-pack Plus PS-2 cartridges

	Sep-Pak	SDB-RPS	SDB-XC	SDB-XD
Number of detected chemicals	68	70	53	54
Number of similar compounds with Sep-Pak		17	14	18

3. Result and Discussion

3.1 Disk Selection

According to the results of field experiment shown in Table 1, the SDB-RPS disk showed the highest number in detected chemicals, and the second best similarity with Sep-Pak in detected compounds. For this reason, SDB-RPS disk is selected to conduct adsorption amount and rate experiment.

3.2 Adsorption amount and rate

Fig. 2 illustrates the relationship between adsorbed amount of triclosan to passive sampler disks and the deployment time, comparing with AS Sep-pack Plus PS-2 cartridges. Results shows that the adsorbed amount of triclosan was very little in the beginning of deployment, then increased slowly from 1day to 2, 3, 7 days, then decreased again for 14 days deployment. The detected triclosan concentration by AS was 14.58μg/L, while the detected concentration by PS was 8.14μg/L after deployment for 3 days.

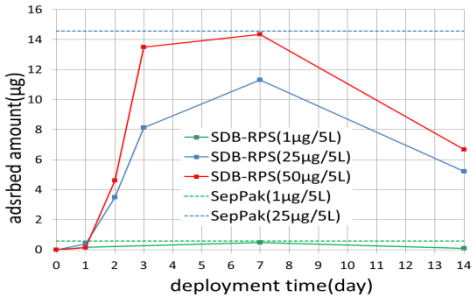

Fig. 2 Adsorbed triclosan amount during deployment time

In case of AS in the field survey, 10 L water sample collected to pass through 4 Sep-pack plus PS-2 cartridges (doubled volume in case of indoor test). So, it is expected that to conduct a comparative toxicity study between AS and PS in field survey, three passive sampler disks must be deployed for at least 3 days in the water stream to achieve (24.42μg/L) almost the same or close to detected triclosan concentration (29.16μg/L) by AS.

Fig. 3 shows the relationship between the concentration of triclosan and its adsorbed amount for each deployment event. For 2, 3, 7 deployment days, the adsorbed amount of triclosan was rather proportional to the concentration, which means the adsorption sites were active in terms of Langmuir adsorption isotherm. For 14 days, the adsorbed amount was lower than 7 days. It might be due to the decrease in number of active adsorption sites or the degradation of adsorbed material after binding to adsorption sites. While, for 1 day deployment, the adsorbed amount was very little and there was no much difference in the adsorbed amount of triclosn at 5μg/L and 10μg/L. It might be due to the number of active adsorption sites was low, and it means that the deployment time of 1 day was not enough for binding.

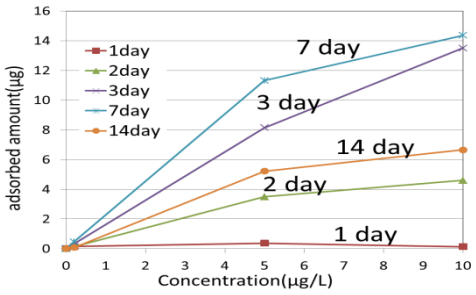

Fig. 3 Effect of concentration on the adsorbed amount

4. Conclusion

It can be concluded that the Passive sampling method can be considered for toxicity assay with a deployment period for at least 3 days for 3 passive sampler disks.

5. References

1. Al-Odaini et al., 2010. J. Chromatogr. A., 1217: 6791- 6806.
2. Branislav Vrana et al., 2005 Trends in Analytical Chemistry, Vol. 24, No. 10.