



POLYCYCLIC AROMATIC HYDROCARBONS IDENTIFICATION IN LAKE SHKODRA WATER BY USING THE MEMBRANE ENCLOSED SILICONE COLLECTOR (MESCO II)

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SYNOPSIS

Key words:

MESCO II,
PAHs,
Shkodra lake.

MESCO II passive samplers were deployed at three sites in the Lake Shkodra over periods of three weeks during the years (2007-2008) in order to monitor the bioavailable fraction of more hydrophobic organic micropollutants. MESCO II samplers consist of a low-density polyethylene bag with heat-sealed segments in which small pieces of flexible silicone rod are placed as receiving phase. After retrieval of the MESCOs from the field, the silicone rod was dismantled from the membrane bags and the accumulated compounds were directly analyzed by thermodesorption – GC/MS. A number of priority polycyclic aromatic hydrocarbons (PAHs) were identified at all sampling points in each year of monitoring period. The presented results showed that the absolute concentration of PAHs ranged from (0,025-1,65 ng/SR).

INTRODUCTION

The Shkodra Lake is located on the border between Montenegro and Albania and has an area of approx. 370 km² – 530 km². The largest inflow is the Morača river (Montenegro), providing more than 62% of the lake water, while Buna/Bojana river (Albania and Montenegro) flows out from the south end and drains into the Adriatic Sea. Industrial growth during a period of almost five decades was not accompanied by adequate technical pollution prevention measures.

The current situation, with human activities including illegal fishing and tourism, as well as poaching, boating, illegal constructions, agriculture, urban

effluents, and the lack of treatment of waste waters polluted by PCBs and heavy metals (red mud disposed by the KAP aluminum plant), endanger the stability of the Lake Shkodra (Skadar Lake) ecosystem (Kantic, 2007).

The exposure of aquatic biota to certain persistent organic pollutants (POPs) is of immediate concern because of the ability of some of these compounds to bioaccumulate and induce either lethal or sub-lethal toxicity including mutagenic, carcinogenic, teratogenic and endocrine disrupting effects on species at all tropic levels and in doing so to disrupt the normal functioning of the whole ecosystem. The pollutants can be present in natural water both freely dissolved and particle-bound and were usually not measured separately. Hence, the bioavailable fraction, which corresponds to the freely dissolved fraction and is very important for ecological risk assessment, is not easily accessible.

Passive sampling techniques can solve this problem and can provide a cost-efficient biomimetic (time-integrative) water monitoring, (Greenwood et al., 2007). The combination of SPMD-based sampling with appropriate bioassays and chemical analysis provided an environmentally relevant tool for the identification of waterborne pollutants in Lake Shkodra/Skadar (Rastall et al., 2004). The membrane-enclosed silicone collector (MESCO II) which consists in a silicone rod enclosed in an air-filled low-density polyethylene membrane bag is developed for monitoring non-polar persistent organic pollutants (POPs), (Wennrich et al., 2003). The aim of this study was the identification of polycyclic aromatic hydrocarbons (PAHs) in Lake Shkodra water by using the membrane enclosed silicone collector (MESCO II).

MATERIALS AND METHODS

The sampling sites for MESCO II deployment are (S1) Zogaj, (S2) Peshkimi (S1) Zogaj, (S3) Zues. The sites were chosen regarding the anthropogenic influence of the villages near the lake.

The MESCO II strip consists of 1.5 cm silicone rods enclosed in low density polyethylene membrane (segmented by heat-sealing). The samplers were prepared in the UFZ Centre in Leipzig, Germany as is described in Paschke et al. (2006), and were shipped to Albania alongside with transportation/trip blanks (additional MESCO strips) necessary to fulfill the requirements of quality control. They were exposed for three weeks in Lake Shkodra water during June- July (2007-2008). The silicon rods for both samplers were processed in a thermodesorption unit TDU – GC/MS as is described in PASCHKE et al. (2006).

Table 1: Absolute concentration in ng/SR (calculated for 1.5 cm SR) of analytes accumulated in MESCO II (N=3).

Sampling sites		S1		S2		S3		
Compound	Year	X Aver.	St.Dev.	X Aver.	St.Dev.	X Aver.	St.Dev.	LOQ
Naphthalene	2007	0.452	0.034	0.353	0.002	0.711	0.038	
	2008	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	-
2- methylnaphthalene	2007	0.299	0.017	<LOD	<LOD	0.345	0.009	0.013
	2008	0.520	0.043	0.391	0.084	0.743	0.028	
1- methylnaphthalene	2007	<LOD	<LOD	<LOD	<LOD	0.257	0.007	0.015
	2008	0.432	0.014	<LOD	<LOD	0.694	0.040	
Biphenyl	2007	0.644	0.410	<LOD	<LOD	0.667	0.052	0.014
	2008	0.134	0.009	<LOD	<LOD	0.196	<LOD	
2.6- dimethylnaphthalene	2007	<LOD	<LOD	<LOD	<LOD	0.272	0.037	0.046
	2008	0.338	0.009	0.408	0.204	0.477	<LOD	
Acenaphthene	2007	<LOD	<LOD	0.290	0.066	<LOD	<LOD	0.021
	2008	0.314	<LOD	0.916	0.907	0.309	<LOD	
1.4.6- trimethylnaphthalene	2007	<LOD	<LOD	0.366	0.088	0.276	0.054	
	2008	0.282	<LOD	0.849	1.004	0.441	<LOD	
Fluorene	2007	0.157	0.005	0.187	0.099	0.160	0.016	0.018
	2008	0.333	0.075	1.268	1.445	0.303	0.005	
Phenanthrene	2007	0.467	0.011	0.283	0.022	0.381	0.079	0.012
	2008	1.365	0.344	1.083	1.052	0.763	0.141	
Anthracene	2007	0.052	0.021	0.054	0.019	0.056	0.015	0.024
	2008	0.204	0.043	0.316	0.147	<LOD	<LOD	
Fluoranthene	2007	0.336	0.047	0.135	0.046	0.122	0.046	0.017
	2008	1.654	0.578	0.445	0.032	0.534	0.060	
Pyrene	2007	0.044	0.009	0.032	0.006	0.025	0.007	0.016
	2008	0.744	0.396	0.140	0.052	0.143	0.019	
Chrysene	2007	0.119	0.004	<LOD	<LOD	<LOD	<LOD	0.026
	2008	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	
Benzo(b)fluoranthene	2007	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.024
	2008	0.632	0.098	0.444	0.186	<LOD	<LOD	
Benzo(a)pyrene	2007	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.054
	2008	0.732	0.139	0.680	0.048	<LOD	<LOD	

RESULTS AND DISCUSSION

A number of PAHs (naphthalene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene), alkylated PAHs (2-methylnaphthalene, 1-methylnaphthalene, 2,6-dimethylnaphthalene, 1,4,6-trimethylnaphthalene) were accumulated in the MESCO II sampler deployed direct in lake water (table 1).

The absolute concentration of analytes in MESCO II samplers deployed in natural water of Lake Shkodra for 21 days is quantified in ng/SR. The presented results showed that the absolute concentration of analytes ranged from (0,025-1,65 ng/SR). There was not identified any analyte in the blank samples. There were analyzed three replicates for each samples and was calculated the average and standard deviation, see table 1.

From the results showed in the table 1 is evidenced that the absolute concentrations has not significant changes regarding the results taken at the same time in different sampling sites and between two expeditions there are significant changes in analyte concentrations.

The higher absolute concentrations are obtained in the year 2008 which indicate the increasing of the pollution in the lake.

CONCLUSIONS

The presence of priority pollutants of polycyclic aromatic hydrocarbons (PAHs) in Shkodra Lake shows the influence of anthropogenic pollution (fuel discharge, fuel combustion, sewage, etc) in the water quality. The MESCO II sampler was successful used for the identification of polycyclic aromatic hydrocarbons (PAHs) in Lake Shkodra water. The presence of bioavailable fraction of polycyclic aromatic hydrocarbons in Shkodra Lake increase risk for toxic effects in Lake Shkodra biota. As anthropogenic influences continue to increase in Shkodra Lake, the identification and monitoring of organic pollutants in the lake Shkodra ecosystem is a challenge of the future research.

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