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The content of polycyclic aromatic carbohydrates in soil samples from the region of Vojvodina

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Polycyclic aromatic carbohydrates (PAH) are a group of organic compounds consisting of two or more fused aromatic rings. PAHs are poorly soluble in water, while readily soluble in organic solvents [1]. The compounds are created as byproducts of incomplete combustion. Major sources of PAH emission into the atmosphere are thermo-energetic plants, gas emissions from petrol- and diesel-fueled cars as well as the intensive activities of chemical industry [2]. Since recently, research of polycyclic aromatic carbohydrates has been gaining much attention, which is due to their established carcinogenic, mutagenic and teratogenic properties [3].

Soil samples were collected from 11 localities in the territory of Vojvodina (Bač, Zmajevo, Despotovo, Čenej, Čurug, Kisač, Bački Brestovac, Bački Jarak, Rumenka) during 2014. All samplings were performed by collecting soil samples from 10-15 different points at the total surface of 100 m². The samples were collected only from flattened soil surface at the depth of 10-20 cm. The majority of soil samples were of “chernozem”-type. The samples were dried at 105ºC until reaching the constant mass. Subsequently, removal of mechanical impurities (mainly stones and plant particles) has been performed. Dried soil samples were mechanically crushed (ground) to obtain fine powder.

Our research involved detection of 16 PAHs in the collected soil samples. The soil is characterized by highest contents of PAH, since majority of these compounds enter the soil via atmospheric precipitation. The sample preparation was performed applying the method of QuEChERS extraction, which yielded high recovery for majority of PAHs. Quechers dispersion sample preparation enabled a rapid, effective and accurate extraction of 16 PAHs from the homogenized sample. To the purpose of maximum effective extraction, pre-preparation of samples was performed implicating drying at ambient temperature for 24 hours and proper homogenization of the sample. Properly dried and homogenized samples were used for PAH extraction and determination of moisture content. Subsequently, 3 g-portions of representative samples were measured, to which 3ml water and 6ml acetonitrile were added. Following intensive vortexing during 1min, extraction-enhancing salts, i.e., 3 g MgSO4(anh) and 1g Na-acetate, were added. After intensive vortexing and obtaining moderate exothermic reaction, the sample was centrifuged at 4000 rpm during 10min. The 1ml aliquot of acetonitrile extract was transferred into the tube containing 150 mg MgSO4, 50 mg PSA and 50 mg C18 for purification and removal of matrix interference. Following the subsequent centrifugation, purified extract was obtained, which was injected into the gas chromatographer with mass detector after evaporation in nitrogen stream until dry and reconstitution with n-hexane. GC/MS analysis was performed using selective ion monitoring (SIM) mode [4]. Such method of sample preparation resulted in a yield ranging between 79 and 93%.

In all analyzed samples, the following compounds were detected: naphthalene, ranging 1.4-9.4 μg/kg; acenaphthylene, ranging 0.6-2.5 μg/kg; acenaphthene, ranging 0.4-1.7 μg/kg; fluorene, ranging 1.2-7.6 μg/kg; phenanthrene, ranging 0.6-7.5 μg/kg; anthracene, ranging 3.6-8.0 μg/kg; fluoranthene, ranging 1.0-10 μg/kg; pyrene, ranging 0.7-8.1 μg/kg and benzo[g,h,i]perylene, ranging 2.4-3.5 μg/kg. Benzo[a]anthracene, benzo[b]fluoranthene, dibenzo[a,h]anthracene and benzo[k]fluoranthene were detected in eight samples, at the levels ranging within intervals of 1.0-
37 μg/kg, 4.7-35 μg/kg, 5.0-38 μg/kg and 5.0-31 μg/kg, respectively. Chrysene was detected in four samples, ranging from 2.0 to 27μg/kg, whereas benzo[a]pyrene was found in five samples at the levels ranging 2.0-91 μg/kg. The contents of indeno[1.2.3-cd]pyrene were below quantification level in all analyzed samples.

According to the obtained results on contents of polycyclic aromatic carbohydrates in the analyzed soil samples originating from different localities in Vojvodina we can conclude (Regulation on the systematic monitoring of soil quality indicators for assessment of risk from land degradation and methodology for development of remediation programs, Off. Gazette of RS, No. 88/2010) that the established level of contamination is low and that concentration of the investigated pollutants is far below the levels that would require implementation of relevant soil remediation measures.

References