Evaluation and Monitoring the Poly Aromatic Hydrocarbons (PAHs) in Tigris River South of Baghdad (IRAQ)

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Abstract

Twelve water samples were collected from four locations in Tigris River near the intake points of several drinking water stations namely Jisser Dyala, Al Towatha, Al Madain and Al Wahda drinking water stations, respectively, in south Baghdad- Iraq. At the same time twelve soil samples were collected from agriculture farms in same area of water sample. Both water and soil samples were collected through April 2012.

The presented results revealed different values for physical, and chemical parameters for both water and soil samples studied. The chromatographic results for evaluation of polyaromatic hydrocarbons (PAHs) using HPLC method, revealed high values in some station in the range between 0.22-52.51 ng/ml for water and 0.21-30.2 ng/ml for soil, which indicated that predominate PAH were Fluoranthene, Pyrene, naphthalene, Benzo (b) fluranthene and Benzo (k) fluranthene derivative in these samples, which were may be diffused from neighboring oil resources. In some polluted soil samples there is a highly elevated in heavy metals and the concentration of nitrate and nitrates ions which might be came from the residue of explosive material during the last war (2003) in Iraq. Soil samples were investigated for its heavy metals content. Samples of soil were analyzed for their content after digestion with nitric acid using atomic absorption spectrometers AAS. The results refer to increase in most of these elements. The aim of this work is to establish a relationship between the pollution levels of different pollutants with medical problems which were recently elevated in these regions (cancer incidents, cardiovascular diseases, digestion disease, genetic mutation in new born children and allergy disease) compared with the international criteria for evaluation these types of diseases status.

Keywords: Polyromantic hydrocarbons; Water analysis; Soil analysis; Iraq environmental.

تقييم ومراقبة الهيدروكربونات العطرية المتعددة (PAHs) في نهر دجلة جنوب بغداد (العراق)

الخلاصة

تم جمع اثني عشر عينة مياه من أربعة مواقع في نهر دجلة بالقرب من نقاط الاستيعاب في العديد من محطات مياه الشرب وهي جسر ديالا ، والتوثا ، والمدائن ، ووحدة مياه الشرب ، على التوالي ، في جنوب بغداد - العراق. في نفس الوقت تم جمع اثني عشر عينة من التربة من المزارع الزراعية في نفس منطقة عينة المياه. تم جمع عينات المياه والتربة حتى أبريل 2012.

كشفت النتائج المقدمة عن قيم مختلفة للمعايير الفيزيائية والكيميائية لعينات المياه والتربة التي تمت دراستها. كشفت النتائج الكروماتوغرافية لتقييم الهيدروكربونات متعددة الحلقات باستخدام طريقة HPLC ، عن وجود قيم عالية في بعض المحطات تتراوح بين 0.22-52.51 نانوغرام / مل للمياه و 0.21-30.2 نانوغرام / مل للتربة ، مما يدل على أن PAH هي الفلورانثين الغالب ، بيرين ، نفثالين ، بنزو (ب) فلورانثين وبنزو (ك) مشتق من الفلورثين في هذه العينات ، والتي قد تنتشر من موارد النفط المجاورة. في بعض عينات التربة الملوثة ، هناك ارتفاع كبير في المعادن الثقيلة وتركيز أيونات النترات والنترات التي يمكن أن تأتي من بقايا المواد المتفجرة خلال الحرب الأخيرة (2003) في العراق. تم فحص عينات التربة لمحتواها من المعادن الثقيلة. تم تحليل عينات من التربة لمحتواها بعد الهضم مع حامض النيتريك باستخدام مطياف الامتصاص الذري. تشير النتائج إلى زيادة في معظم هذه العناصر.

الهدف من هذا العمل هو إقامة علاقة بين مستويات تلوث مختلف الملوثات التي تعاني من مشاكل طبية والتي ارتفعت مؤخرًا في هذه المناطق (حوادث السرطان وأمراض القلب والأوعية الدموية وأمراض الهضم والطفرات الوراثية لدى الأطفال حديثي الولادة وأمراض الحساسية) مقارنةً بمعدلات التلوث المعايير الدولية لتقييم هذه الأنواع من حالة الأمراض.

الكلمات المفتاحية: الهيدروكربونات المتعددة البروم؛ تحليل المياه تحليل التربة البيئة العراقية.

Introduction:

Polycyclic aromatic hydrocarbons (PAHs) represent a wide spread class of environmental chemical pollutants and are ubiquitous contaminants with two or more fused aromatic rings in marine environments. PAHs' solubility in water decreases, while correspondingly their boiling and melting point increases, with increasing molecular weight [1]. PAHs are lipophilic compounds with very low water solubility and therefore, their concentration in water is very low [2, 3]. As a consequence of their hydrophobic nature, PAHs in aquatic environments rapidly tend to become associated to the particulate matter ending in sedimentation. Therefore, sediments represent the most important reservoir of PAHs in the marine environment. For that reason, PAHs accumulation in coastal sediments is both due to anthropogenic and natural emissions.

The release of massive amounts of oil combustion related pollutants are common in oilfields and around refineries in Iraq. There are many persistent and less biodegradable compounds in petroleum that could easily enter the food chain. Petroleum-derived compounds, such as saturated hydrocarbons and polycyclic aromatic hydrocarbons (PAHs) are widespread environmental contaminants and many of them are known as potent carcinogens. Zare-maivan demonstrated chromosome aberration in lima beans exposed to petroleum in vitro [4]. Saeed demonstrated presence of PAHs because of Iraq-Kuwait war in the atmosphere of Kuwaiti towns with potential health hazards [5]. Since, PAHs are persistent in the environment and plants, as primary producers of the ecosystem can absorb PAHs, plant parts of two prominent species of halophytes. Accumulation of metals in plants is highly dependent on their availability in soil. Partitioning of metals over the solid phases and soil solution is affected by soil characteristics of which pH are the most important. Environmental pollution and exposure to toxic material is an increasingly serious problem the world over. The unscientific use of hazardous materials in agriculture and industries and its dumping has created a great risk for human life, plants and animals. Similarly the heavy metals are assimilated in the environment from vehicle exhaust, from the smoke of industries or the spreading of industrial effluents through water in soil [6, 7].

Tigris River is the most important river in Iraq, runs from north to south through the Baghdad city, which provides for agriculture irrigation and drinking water stations. This ecosystem during the years, due to its closeness to the town and to the richness of human activities (e.g. industrial, aquaculture and urban activities) have accumulated in sediments both high PAHs and organic matter levels, so the goal of this work is to study the concentrations distribution of the sixteen PAHs in twelve sectors in Tigris River south of Baghdad.

Martial and Methods:

Water samples were collected during the period from 1st to 30th April 2012 from four sites stations south of Baghdad namely Jisser Dyala, Al Towatha, Al Madden and Al Wehda stations (25-30 Km) south Baghdad, while soil samples were collected from the agriculture fields near by these stations intakes. River water samples (2 L) were collected in glass bottles, covered with screw caps, while the soil samples (about 1 kg each) were collected in glass packaging, all samples were immediately transported to the laboratory for analysis. Area research is shown on the map (Fig. 1).

Our samples were collected, transported in a cool box to the analysis laboratory, and then stored at 20^{o}C before analysis. High performance liquid chromatography (Shimadzu LC-10 AVP HPLC) technique used to analyze PAHs. The other water parameters were analyzed by using the following instruments: pH meter (WTW), Conductivity meter (WTW), Colony counter, Microscope (Olympus), Turbidity meter (WTW), Shimadzu UV-vis 1700, Ion selective meter (WTW) and Atomic absorption spectroscopy Shimadzu 3600 (AAS). De-ionized water was used in the preparation of all solutions.

Results and discussion:

As we mentioned above, twelve water samples and twelve soil samples were collected from the research area during April 2012, as indicated in the illustrated map Fig. 1. The laboratories analyses were carried out for these samples for determine the concentration ratios of PAHs. The results were listed in Tables (1 and 2) for both water and soil samples, while Figs (2 and 3) showed the distribution of Total L. PAHs and Total H. PAHs within the intakes of four drinking water stations starting from the 1st one (Jisser Dyala) to 2nd one (Al Towatha) to the 3rd one (Al Madain) to the 4th one (Al Wahda), It was showing that the PAHs concentration in ng/l significantly increased from the 1st station to the 4th station, due to the polluted sources from (Al Dora refinery, the previous Iraqi nuclear stores and relating buildings, Al Rustameah swage water station, different factories and plants for produce leathers, chemicals, dyes, rubbers, plastics, textiles, power stations and hospitals for transmitted disease.

Table 3 illustrated the laboratory analysis results for soil samples, which show a clear rise in the rates of heavy metals, nitrates and nitrites, which refer to clear pollution. The elevated results confirm that these areas are considered to be oil producing regions and busiest in cars traffic. Therefore, it necessary to highly confirm the need for baseline data to reveal the background levels, and the chronic oil pollution in such vital areas from industrial and other anthropogenic sources, which is described in some literature as "acute oil pollution". The observation we did in this area gave us a good indications for the increasing the cancer incidents and new diseases which appeared in these locations.

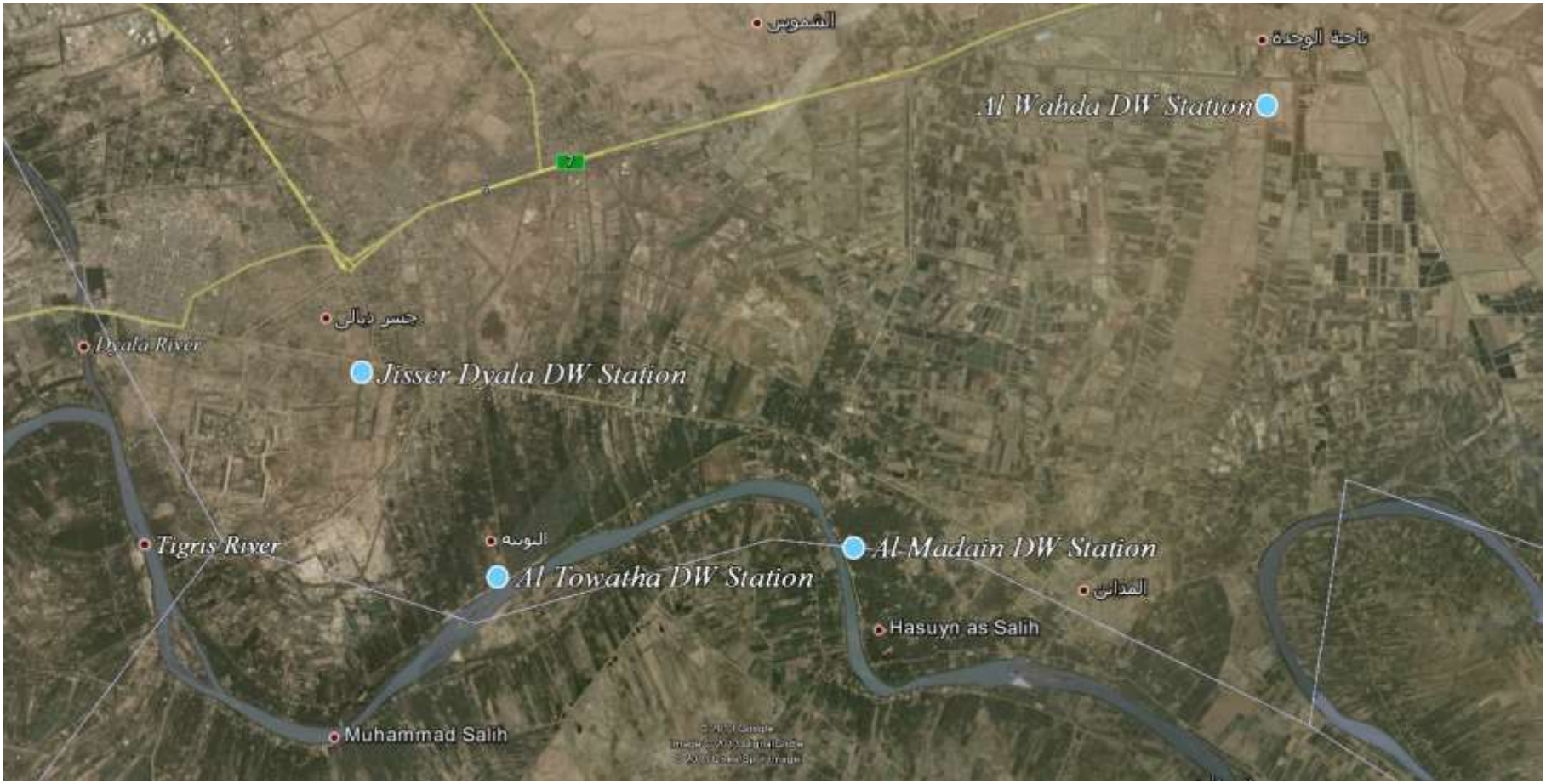


Fig. 1: The map of research area and the four sampling stations in Tigris and Dyala river sector south of Baghdad

Table 1: PAHs (ng/L) in Tigris River (surface water)

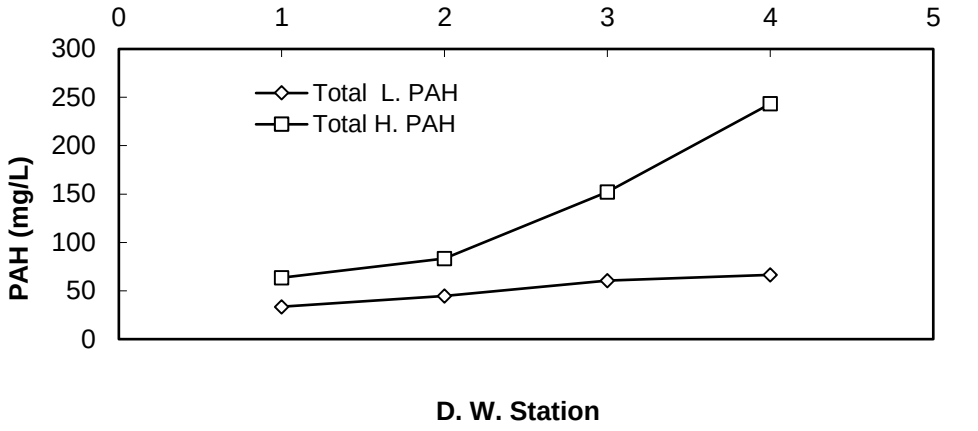
Compound	**Site 1**	**Site 2**	**Site 3**	**Site 4**
Naphthalene	8.50	8.41	11.22	16.37
Acenaphthylene	5.90	6.27	12.15	13.51
Acenaphthene	5.85	11.24	15.01	10.37
Fluorene	4.24	6.21	8.17	7.93
Phenenthrene	3.88	6.00	6.19	5.92
Anthracene	5.18	6.42	7.82	12.35
Total L. PAH	33.55	44.55	60.56	66,45
Fluoranthene	20.18	24.20	52.51	76.71
Pyrene	10.96	12.39	22.35	35.66
Benzo (a) anthracene	8.44	16.53	31.25	35.91
Chrysene	5.89	10.30	19.50	24.08
Benzo (b) fluranthene	3.87	4.98	6.04	20.18
Benzo (k) fluranthene	1.31	1.66	2.41	16.69
Benzo (a) pyrene	2.11	3.56	4.20	13.22
Dibenzo(a,h) anthracene	4.23	4.61	6.77	9.72
Benzo(g,h,i) perylene	5.18	3.98	6.92	10.00
Indeno(1,2,3-cd) pyrene	1.10	0.99	0.22	1.21
Total H. PAH	63.27	83.2	152.17	243.38

Table 2: PAHs (ng/L) in soil agriculture samples near Tigris River sampling area

Compound	**Site 1**	**Site 2**	**Site 3**	**Site 4**
Naphthalene	7.9	10.5	12.4	25.9
Acenaphthylene	5.2	8.7	15.5	20.8
Acenaphthene	9.5	17.4	22.1	30.7
Fluorene	2.9	5.6	10.7	16.3
Phenenthrene	5.2	11.2	18.9	30.2
Anthracene	4.1	7.2	25.2	33.7
Total L. PAH	34.8	60.6	104.8	157.6
Fluoranthene	0.88	1.23	2.81	6.1
Pyrene	0.63	0.99	2.98	5.4
Benzo (a) anthracene	1.01	1.23	3.14	5.1
Chrysene	0.69	2.81	4.00	4.8
Benzo (b) fluranthene	0.99	1.68	3.24	4.43
Benzo (k) fluranthene	1.12	0.57	1.61	1.59
Benzo (a) pyrene	1.40	0.46	2.78	3.88
Dibenzo(a,h) anthracene	0.43	0.52	0.99	1.52
Benzo(g,h,i) perylene	0.28	0.87	2.02	3.11
Indeno(1,2,3-cd) pyrene	1.21	0.21	0.74	0.88
Total H. PAH	8.64	12.57	24.31	36.81

Table 3: Soil analysis in four sites in research area

Analysis	**Site 1**	**Site 2**	**Site 3**	**Site 4**
Arsenic (ppm)	0.15	0.15	0.29	0.29
Aluminium (ppm)	0.012	0.012	0.016	0.016
Barium(ppm)	12.65	12.65	18.92	18.92
Calcium (ppm)	128.3	128.3	152.5	152.5
Cadmium (ppm)	0.321	0.321	0.398	0.398
Copper (ppm)	35.2	35.2	15.64	15.64
Iron (ppm)	23000	23000	21000	21000
Lead (ppm)	0.521	0.521	0.652	0.652
Mercury (ppm)	0.22	0.22	0.35	0.35
Magnesium (ppm)	10900	10900	9800	9800
Manganese (ppm)	600	600	620	620
Sodium (ppm)	33600	33600	15600	15600
Selenium (ppm)	0.607	0.607	0.702	0.702
Zinc (ppm)	76.8	76.8	62.5	62.5
pH	6.58	6.58	7.02	7.02
NO_2 (ppm)	1.23	1.23	3.98	3.98
NO_3 (ppm)	2.56	2.56	7.25	7.25



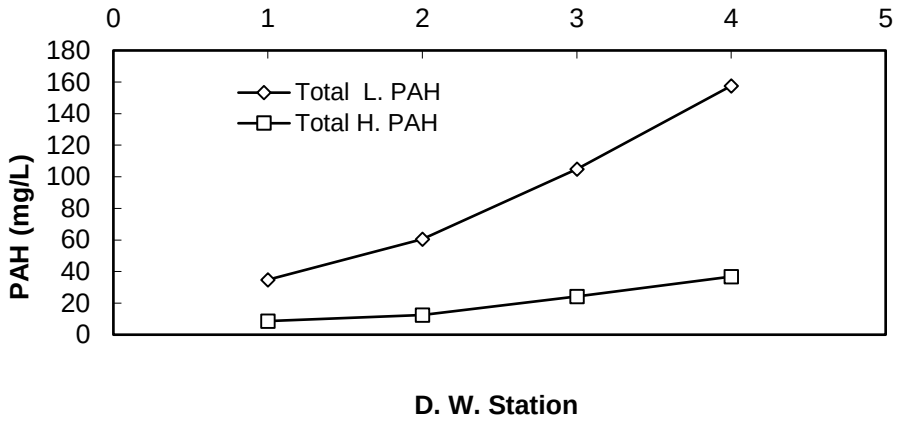


Fig. 3: Total L.PAHs Total H. PAHs distribution for soil samples

Conclusion:

Results obtained with the present study provided useful information in order to evaluate PAHs contamination in Tigris river water and agriculture soil samples in the same area. In water samples, Total L. PAHs and Total H. PAHs refer to increasing from the frist location to the final one. The chromatographic results for (PAHs) indicated that predominate were

Fluoranthene, Pyrene, naphthalene, Benzo (b) fluranthene and Benzo (k) fluranthene derivative in these samples.

The study showed that these locations south of Baghdad grown in contaminated areas have high risk of having heavy metal concentrations beyond the permissible limit for each of them as compared to the less contaminated areas.

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