Contamination of Polycyclic aromatic hydrocarbon compounds and Impact on fungi in water of Al-Najaf Sea

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Abstract

Organic pollution with Polycyclic aromatic hydrocarbons (PAHs) in environmental as a result of waste and heavy waters and natural pyrolysis of natural compounds and chemicals material. Sixteen of those combined had been classified as human carcinogen, in this have a look at six locations were collected samples from it ,which have been decided on randomly. The result showed variance from site to another , in concentration of pollutants and decrease of fungi as organisms in water work as bioremediation for chemical compounds and comparative with indicate of WHO. Naphthalene showed various concentrations was (0.547, 0.99,0.177,0.020,0.001,0.033) µg/ml, while was Tetraphan showed (0.184, 1.47, 0.195, 0.87,0.032, 0.039) µg/ml, whereas was Acenaphthylene showed (0.217, 0.043, 2.136, 2.322,0.037,0.055) µg/ml, Fluorene was (0.156,0.171,1.639,0.013, 0.029, 0.0422 ) µg/ml, Phenanthrene was (0.420, 0.095, 0.096, 0.0072, 56.93, 0.023) µg/ml, Anthracene was (1.72, 0.056, 0.534, 0.062, 0.187, 0.0045 ) µg/ml, Pyrene was (0.0127, 0.0157, 0.039, 0.006, 0.00014, 0.0071) µg/ml, Benz(a) anthracene was (0.036, 0.045,0.114, 0.023, 0.0024, 0.00311) µg/ml, Chrysene was (0.208, 0.341, 0.539, 0.21, 0.622, 0.032) µg/ml, Benzo(a) fluoranthene was (0.011, 0.074, 0.068, 0.010,0.0017, 0.0078 ) µg/ml, and Diben (ah) anthracene (0.139, 0.206, 0.188, 0.066, 0.0047, 0.021 ) µg/ml. The results showed the isolation of three genera of fungi from six locations, where the Aspergillus spp. was the most common fungi by 58.82%, followed by the Alternaria spp. by 24.85% , while the Penicillium spp. accounted for 16.33% (table 2). These results were agreed with (33).

Keywords: Polycyclic aromatic hydrocarbons, pollutant waters, fungi.

Introduction:

Polycyclic aromatic hydrocarbons (PAHs) were hydrophobic and did not now simply of solve in the water or sublimate (volatilize) to the atmosphere (that aside from naphthalene, which was as soon as used in mothballs)(1,4). The steadiness of chemical
compounds, decreased water solubility and ability of excessive sorption to (PAHs) contribute by greatly their persistence in the environment (5-6). Polycyclic aromatic hydrocarbons can were divided to: low molecular weight composed of less than four ring (naphthalene; acenaphthene; fluorine and phenanthrene)(3,5). High molecular weights composed of 4 rings (pyrene; chrysene, benzo(a)pyrene and dibenz(a,h)anthracene). PAHs of high molecular weight were generally much less water soluble(6-8) it were evaporation of lower under pressures according Henry’s constants(9). PAHs were ubiquitous at the environment (water, soil and air), it formed predominantly via with incomplete combustion of materials as herbal sources and another organic material (forest fires, volcanic events), and anthropogenic activities (coal, vehicle exhaust, , industrial production and smoking)(10-13). sixteen of PAHs as dangerous pollutants in USEPA in ecosystem (14). Seven of PAHs cause cancer in human and animals (15). Benzo[a]pyrene was considered the highest cancers among between sixteen of PAHs (16,17).

Materials and methods:

**Sample collection:** Six different random locations from water of AL-Najaf sea were chosen for purpose of collecting study samples and detecting hydrocarbon pollutants as well as the presence of microorganisms in them (fungi) and comparing them with international standards.

**GC assay:** the samples of waters were injected in GC device by used specialized column under 250 C, as well as 2ml injected of pillar kind Ph-5 (30m * 0.25mm * 0.25mm) prepared with ionization (ionize) retriever, Ph-5 pillar, after pattern strip, a part of reproducer 2ml inoculated via micro syringe in column of GC device and within 15 min. we get the results of samples examination.

**Result and discussion:**

The development in the field of industry in addition to agriculture, as well as the high population and the waste resulting from all of this, caused a great pollution, which had a clear impact by revealing the percentage of fungi in the water, which is a vital treatment for pollutants. Where their presence rates were very low compared to global standards Identified by the World Health Organization. Pollution with cyclic hydrocarbons in water directly threatens aquatic plants and then aquatic animals and thus is a danger to human life through the transmission of these pollutants to the human body through feeding it on fish and causing various diseases, the most dangerous of which are cancer diseases.

| No. | Compounds µg/ml Location | L.S.D |
|-----|--------------------------|-------|
| 1   |                         | 2     |
| 2   |                         | 3     |
| 3   |                         | 4     |
| 4   |                         | 5     |
| 5   |                         | 6     |

Table (1). Concentrations of Polycyclic aromatic hydrocarbons (PAHS).
| 1.   | Naphthalene | 0.547 | 0.99  | 0.177 | 0.020 | 0.001 | 0.033 | 0.02 |
| 2.   | Tetraphan   | 0.184 | 1.47  | 0.195 | 0.87  | 0.032 | 0.039 | 0.01 |
| 3.   | Acenaphthylene | 0.217 | 0.043 | 2.136 | 2.322 | 0.037 | 0.055 | 0.04 |
| 4.   | Fluorene    | 0.156 | 0.171 | 1.639 | 0.013 | 0.029 | 0.0422| 0.01 |
| 5.   | Phenanthrene| 0.420 | 0.095 | 0.096 | 0.0072| 56.93 | 0.023 | 0.02 |
| 6.   | Anthracene  | 1.72  | 0.056 | 0.534 | 0.062 | 0.187 | 0.0045| 0.01 |
| 7.   | Pyrene      | 0.0127| 0.0157| 0.039 | 0.006 | 0.00014| 0.0071| 0.002|
| 8.   | Benz(a) anthracene | 0.036 | 0.045 | 0.114 | 0.023 | 0.0024| 0.00311| 0.01 |
| 9.   | Chrysene    | 0.208 | 0.341 | 0.539 | 0.21  | 0.622 | 0.032 | 0.02 |
| 10.  | Benz(a) fluoranthene | 0.011 | 0.074 | 0.068 | 0.010 | 0.0017| 0.0078| 0.03 |
| 11.  | Dibenzo(ah) anthracene | 0.139 | 0.206 | 0.188 | 0.066 | 0.0047| 0.021 | 0.01 |
Figure (1-11) Concentrations of Polycyclic aromatic hydrocarbons (PAHS) in the waters of AL-Najaf sea.

the manufacturing consequent and civilization sundry sorts of pollutants detection their pattern into all elements of environment. Polycyclic aromatic hydrocarbon (PAHS) were can created and launched to the surroundings by cause of in completed burning or due to pyrolysis of organic matter and gas, for duration of industrial procedures and other efficacies for human(14). Water pollution with (PAHs) were belong to the anthropogenic emissions that appeared of most important exporter of (PAHs) complex that was
similarity to industrial supply as pollutants. (PAHs) compounds have more dangerous deserved to human existence. The power of (PAHs) inside the watery milieu was critical and statistics at the manufacturing and this study indicator as dangerous locations on human health through pollutant material in it found. standard of (PAHs) in the prior period through were pronounced and anthropogenic starting from place and dangerous related because of their molecular weights and increased of concentration in the environments. Samples collection from six locations of surface water for AL-Najaf sea had been amassed from different site that were selected in randomly. The result showed variance from site to another as clear in table(1).Naphthalene showed various concentrations was (0.547, 0.99,0.177,0.020,0.001,0.033) µg/ml , while was Tetraphan showed (0.184,1.47 , 0.195, 0.87,0.032,0.039) µg/ml , whereas was Acenaphthylene showed (0.217,0.043, 2.136, 2.322, 0.037,0.055) µg/ml , Fluorene was (0.156,0.171,1.639,0.013,0.029,0.0422 ) µg/ml , Phenanthrene was (0.420,0.095,0.096,0.0072,56.93,0.023 ) µg/ml , Anthracene was (1.72, 0.056, 0.534, 0.062, 0.187, 0.0045 ) µg/ml , Pyrene was (0.0127, 0.0157, 0.039, 0.006, 0.00014, 0.0071) µg/ml , Benz(a) anthracene was (0.036, 0.045, 0.114, 0.023, 0.0024, 0.00311) µg/ml , Chrysene was (0.208,0.341, 0.539,0.21, 0.622, 0.032 ) µg/ml , Benzo(a) fluoranthene was (0.011, 0.074, 0.068,0.010,0.0017, 0.0078) µg/ml , and Dibenz (ah) anthracene (0.139, 0.206, 0.188, 0.066, 0.0047, 0.021 ) µg/ml. These results agreed with a number of researchers (18-33) and non-agreed with (9-17).

The results showed the isolation of three genera of fungi from six locations, where the Aspergillus spp. was the most common fungi by 58.82%, followed by the Alternaria spp. by 24.85%, while the Penicillium spp. accounted for 16.33% (table 2). These results were agreed with (33).

| No. | Isolated Fungi      | locations | percentage | Rate of Repetition | L.S.D. |
|-----|---------------------|-----------|------------|--------------------|--------|
| 1   | Aspergillus spp.    | 16        | 13         | 9                  | 17     | 9       | 7       | 58.82% | 16     | 2.3    |
| 2   | Alternaria spp.     | 4         | 5          | 6                  | 4      | 6       | 4       | 24.85% | 10     | 1.6    |
Figure (12-14) isolated fungi from six locations in waters of Al-Najaf Sea.

The effect of Polycyclic aromatic hydrocarbon compounds were negative in the growth of most types of fungi, while there are some genera and types of them that bear the increase in the percentage of PAHs (18).

Conclusions:
The results showed display a high variance in found of (PAHS) as pollutants in waters of AL-Najaf sea from location to another. it was cause of dangerous diseases in humans, it was cancer the first dangerous on the humans and more another diseases, another conclusion was the effect of these chemical compounds on the fungi through their small numbers, and the creation of genetic mutations in the genetic material of many strains of fungi, even though they work on the biological treatment of these chemical compounds. This was another evidence of the danger of these pollutants on human health, aquatic animals and plants.
References:

1- Harvey, R.G., 1991. Polycyclic aromatic hydrocarbons: chemistry and carcinogenicity. Cambridge University Press: Cambridge, 396 pgs. ISBN 978-0521292047

2- U.S. Environmental Protection Agency, 1993. Provisional guidance for quantitative risk assessment of polycyclic aromatic hydrocarbons. EPA 600-R-93-089. Report pdf

3- Keith, L. and Telliard, W., 1979. ES&T special report: priority pollutants: I-a perspective view. Environmental Science & Technology, 13(4), 416-423. doi: 10.1021/es60152a601

4- LaGoy, P.K., Quirk, T.C., 1994. Establishing generic remediation goals for the polycyclic aromatic hydrocarbons: critical issues. Environmental Health Perspectives

5- Kanaly, R.A., Harayama, S., 2000. Biodegradation of high-molecular-weight polycyclic aromatic hydrocarbons by bacteria. Journal of Bacteriology, 182(8), 2059-2067. doi: 10.1128/JB.182.8.2059-2067.2000

6- Van Hamme, J.D., Singh, A., Ward, O.P., 2003. Recent advances in petroleum microbiology. Microbiology and Molecular Biology Reviews, 67(4), 503-549. doi: 10.1128/MMBR.67.4.503-549.2003

7- LaGrega, M.D., Buckingham, P.L., Evans, J.C., 2001. Hazardous waste management: 2nd edition. McGraw-Hill, Boston. ISBN 1577666933.

8- National Research Council (US). Committee on Bioavailability of Contaminants in Soils and Sediments, 2003. Bioavailability of contaminants in soils and sediments: Processes, tools, and applications. Washington, DC: National Academies Press., 432 pgs. doi: 10.17226/10523

9- Mackay, D., Shiu, W.Y., Ma, K.C., 1997. Illustrated handbook of physical-chemical properties of environmental fate for organic chemicals.

10- ATSDR, 2015. Comprehensive environmental response, compensation, and liability act (CERCLA) priority list of hazardous substances.

11- Ortega-Calvo, J.J., Harmsen, J., Parsons, J.R., Semple, K.T., Aitken, M.D., Ajao, C., Eadsforth, C., Galay-Burgos, M., Naidu, R., Oliver, R., Peijnenburg, W.J., Römbke, J., Streck, G., Versonnen, B. 2015. From bioavailability science to regulation of organic
chemicals. Environmental Science & Technology, 49(17), 10255-10264. doi:10.1021/acs.est.5b02412.
12- Bosma, T.N., Middeldorp, P.J., Schraa, G., Zehnder, A.J., 1997. Mass transfer limitation of biotransformation: quantifying bioavailability. Environmental Science & Technology, 31(1), 248-252. doi: 10.1021/es960383u
13- Ehlers, L.J., Luthy, R.G., 2003. Contaminant bioavailability in soil and sediment. Environmental Science & Technology, 37, 295A-302A.
14-Wick, A.F., Haus, N.W., Sukkariyah, B.F., Haering, K.C., Daniels, W.L., 2011. Remediation of PAHS-contaminated soils and sediments: a literature review. Virginia Polytechnic Institute and State University, USA
15-Zhou J.L., Hong H., Zhang Z., Maskaoui K. and chen W. 2000 Distribution of organic micro pollutants in Xiamen Harbour, China. Water research, 34,2132-2150
16-Amoore JE, Hautala E (1983). "Odor as an aid to chemical safety: Odor thresholds compared with threshold limit values and volatiles for 214 industrial chemicals in air and water dilution". J Appl Toxicology, 3 (6): 272–290.
17-"Phenanthrene Fact Sheet" (PDF). archive.epa.gov. U.S. Environmental Protection Agency. Retrieved 19 July 2019.
18-Lindsey, Jonathan; et al. "Anthracene". PhotochemCAD. Retrieved 20 February 2014.
19-"Benzo[a]anthracene [MAK Value Documentation, 2012]". The MAK-Collection for Occupational Health and Safety. Wiley-VCH Verlag GmbH & Co. KGaA. 2002. pp. 231–242.
20-Chisholm, Hugh, ed. (1911). "Chrysene" . Encyclopædia Britannica. 6 (11th ed.). Cambridge University Press. p. 319.
21-Anja Sörensen and Bodo Wichert "Asphalt and Bitumen" in Ullmann's Encyclopedia of Industrial Chemistry Wiley-VCH, Weinheim, 2009.
22-EFSA Panel on Contaminants in the Food Chain (CONTAM) (2008). Polycyclic Aromatic Hydrocarbons in Food: Scientific Opinion of the Panel on Contaminants in the Food Chain (Report). Parma, Italy: European Food Safety Authority (EFSA). pp. 1–4.
23-ATSDR, Environmental Medicine; Environmental Health Education (2011-07-01). "Toxicity of Polycyclic Aromatic Hydrocarbons (PAHSs): Health Effects Associated With PAHS Exposure". Retrieved 2016-02-01.
24-Walker, T. R.; MacAskill, D.; Rushton, T.; Thalheimer, A.; Weaver, P. (2013). "Monitoring effects of remediation on natural sediment recovery in Sydney Harbour, Nova Scotia". Environmental Monitoring and Assessment. 185 (10): 8089–107. doi:10.1007/s10661-013-3157-8. PMID 23512488.

25-Walker, T. R.; MacAskill, D.; Weaver, P. (2013). "Environmental recovery in Sydney Harbour, Nova Scotia: Evidence of natural and anthropogenic sediment capping". Marine Pollution Bulletin. 74 (1): 446-52.

26- Walker, T. R.; MacAskill, N. D.; Thalheimer, A. H.; Zhao, L. (2017). "Contaminant mass flux and forensic assessment of polycyclic aromatic hydrocarbons: Tools to inform remediation decision making at a contaminated site in Canada". Remediation Journal. 27 (4): 9–17.

27-Choi, H.; Harrison, R.; Komulainen, H.; Delgado Saborit, J. (2010). "Polycyclic aromatic hydrocarbons". WHO Guidelines for Indoor Air Quality: Selected Pollutants. Geneva: World Health Organization.

28-Johnsen, Anders R.; Wick, Lukas Y.; Harms, Hauke (2005). "Principles of microbial PAHS degradation in soil". Environmental Pollution. 133 (1): 71–84.

29-Mackay, D.; Callcott, D. (1998). "Partitioning and physical chemical properties of PAHSs". In Neilson, A. (ed.). PAHSs and Related Compounds. The Handbook of Environmental Chemistry. Springer Berlin Heidelberg. pp. 325–345.

30-Atkinson, R.; Arey, J. (1994-10-01). "Atmospheric chemistry of gas-phase polycyclic aromatic hydrocarbons: formation of atmospheric mutagens". Environmental Health Perspectives. 102: 117–126.

31-Srogi, K. (2007-11-01). "Monitoring of environmental exposure to polycyclic aromatic hydrocarbons: a review". Environmental Chemistry Letters. 5 (4): 169–195.

32-Haritash, A. K.; Kaushik, C. P. (2009). "Biodegradation aspects of polycyclic aromatic hydrocarbons (PAHSs): A review". Journal of Hazardous Materials. 169 (1–3): 1–15.

33. Hazim A.Walli. Determination of PAHs in Surface Water of AL-Dalmaj Marsh ,AL-Diwanyia Province ,Iraq,5(2015).234-238.