

## High Performance Liquid Chromatographic Identification and Estimation of Phthalates in Sewer Waste and a Receiving River in Ibadan City, Southwestern Nigeria

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### ABSTRACT

Medical wastes have been implicated in river pollution in developing countries and most often people depend on water from such rivers for sources of livelihood. Phthalates (endocrine disruptors) are major components in medical wastes and are commonly found contaminants in aquatic environment. Most sewage treatment facilities handling medical waste are inefficient due to overuse and poor maintenance and discharge directly into rivers. This study aimed to investigate the identity and estimates the concentration of phthalates in supposed treated medical wastes from a hospital sewer and water from a receiving river. Samples were randomly collected before and after treatment by the sewer plants, while samples were randomly collected along the course of the river starting from point of discharge. Control samples were taken from upstream about 500 m along the river course. The samples were extracted by liquid-liquid chromatographic process using dichloromethane, after which they were cleaned up in a column of silica gel using hexane as the mobile solvent. The cleaned extracts were analyzed by HPLC. The concentrations ( $\mu\text{g/L}$ ) of dimethyl-, diethyl-, diphenyl-, dibutyl- and di-(2-ethyl)hexyl phthalates ranged from  $62.81 \pm 18.53$ ;  $4.74 \pm 3.57$ ;  $2.05 \pm 1.80$ ;  $11.40 \pm 5.58$  to  $141.92 \pm 35.8$  respectively in the sewer waste. The receiving river had a concentration ( $\mu\text{g/L}$ ) of  $9.17 \pm 14.02$ ;  $0.18 \pm 0.31$ ;  $0.48 \pm 0.84$ ;  $2.84 \pm 1.21$ ;  $61.72 \pm 38.35$  respectively for dimethyl-, diethyl-, diphenyl-, dibutyl- and di-(2-ethyl) hexyl phthalates. These concentrations were higher than control and far exceeded the USEPA limits of  $3 \mu\text{g/l}$  recommended for phthalates in water. Contaminants of aquatic environment by untreated wastes from hospitals has serious implications on public health and environment as human risks for phthalate esters downstream are high and this calls for urgent need to develop strategy to build incentives for compliance in treatment and discharge of wastes into river waters.

### KEYWORDS

Sewage Treatment; Phthalates; Liquid-Liquid Extraction; Clean-Up; Effluent; Toxicity

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### References

- [1] B. C. Blount, K. E. Milgram, M. J. Silva, N. A. Malek, J. A. Reidy and L. L. Needham, " Quantitative Detection of Eight Phthalate Metabolites in Human Urine Using HPLC-APCI-MS/M," *Analytical Chemistry*, Vol. 72, No. 17, 2000, pp. 4127-4134. doi:10.1021/ac000422r
- [2] R. W. Moore, T. A. Rudy, T. Lin, K. Ko and R. E. Peterson, " Abnormalities of Sexual Development in Male Rats Uterus and Lactational Exposure to the Antiandrogenic Plasticizers Di-(2-Ethylhexyl) Phthalate," *Environmental Health Perspectives*, Vol. 109, 2001, pp. 229-237. doi:10.1289/ehp.01109229
- [3] M. L. Ward, G. Bitton and T. Townsend, " Heavy Metal Binding Capacity (HMBC) of Municipal Solid Waste Landfill Leachates," *Chemosphere*, Vol. 60, No. 2, 2005, pp. 206-215. doi:10.1016/j.chemosphere.2004.12.054

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- [4] M. Ema, E. Miyawaki and K. Kawashima, " Effects of Dibutyl Phthalate on Reproduction Function in Pregnant a Pseudo Pregnant Rats," *Reproductive Toxicology*, Vol. 14, No. 1, 2000, pp. 13-19. doi:10.1016/S0890-6238(99)00066-0
- [5] I. Colon. D. Caro, C. J. Bourdony and O. Rasario, " Identification of Phthalate Esters in the Serum of Young Puerto Rican Girls with Premature Breast Development," *Environmental Health Perspectives*, Vol. 108, No. 9, 2000, pp. 895-900. doi:10.1289/ehp.00108895
- [6] S. H. Swan, K. M. Main, F. Liu and S. L. Stewart, " Decrease in Anogenital Distance among Male Infants with Prenatal Phthalate Exposure," *Environmental Health Perspectives*, Vol. 113, No. 8, 2005, pp. 1056-1061. doi:10.1289/ehp.8100
- [7] J. S. Fisher, " Human Testicular Dysgenesis Syndrome: A Possible Model Using In-Utero Exposure of the Rat to Dibutyl Phthalate," *Human Reproduction*, Vol. 18, No. 7, 2003, pp. 1383-1394. doi:10.1093/humrep/deg273
- [8] S. M. Duty, M. J. Silva, D. B. Barr, J. W. Brock, L. Ryan, Z. Chen, R. F. Herrick, D. C. Christiani and R. Hauser, " Phthalate Exposure and Human Semen Parameters," *Epidemiology*, Vol. 14, No. 3, 2003, pp. 269-277. doi:10.1097/01.EDE.0000059950.11836.16
- [9] R. Rozati, P. P. Reddy, P. Reddanna and R. Mujtaba, " Role of Environmental Estrogens in the Deterioration of Male Factor Fertility," *Fertility and Sterility*, Vol. 78, No. 6, 2002, pp. 1187-1194. doi:10.1016/S0015-0282(02)04389-3
- [10] G. Latini, " In-Utero Exposure to Di-(2-ethylhexyl) Phthalate and Human Pregnancy Duration," *Environmental Health Perspectives*, Vol. 111, No. 4, 2003, pp. 1783- 1785. doi:10.1289/ehp.6202
- [11] J. J. K. Jaakkola, L. Oie and P. Nafstad, " Interior Surface Materials in the Home and the Development of Bronchial Obstruction in Young Children in Oslo, Norway," *American Journal of Public Health*, Vol. 89, No. 2, 1999, pp. 188-192. doi:10.2105/AJPH.89.2.188
- [12] J. A. Hoppin, R. Ulmer and S. J. London, " Phthalate Exposure and Pulmonary Function," *Environmental Health Perspectives*, Vol. 112, No. 5, 2004, pp. 571-574. doi:10.1289/ehp.6564
- [13] C. G. Bornehag, J. Sundell and C. J. I. Weschler, " The Association between Asthma and Allergic Symptoms in Children and Phthalates in House Dust: A Nested Case- Control Study," *Environmental Health Perspectives*, Vol. 112, No. 14, 2004, pp. 1393-1397. doi:10.1289/ehp.7187
- [14] K. Kato, M. J. Silva, L. L. Needham and A. M. Calafat, " Determination of 16 Phthalate Metabolites in Urine using Automated Sample Preparation and On-Line Pre- Concentration/High Performance Liquid Chromatography/Tandem Mass Spectrometry," *Analytical Chemistry*, Vol. 77, No. 9, 2005, pp. 2985-2991. doi:10.1021/ac0481248
- [15] European Environmental Agency (EEA), " Comparative Research in Endocrine Disrupters, Phylogenetic Approach and Common Principles Focusing on Androgenic/ Antiandrogenic Compounds (COMPRENDO)," Copenhagen, 2005.
- [16] M. J. Silva, J. A. Reidy, E. Samander, A. R. Herbert, L. L. Needham and A. M. Calafat, " Detection of Phthalates Metabolites in Human Saliva," *Archives of Toxicology*, Vol. 79, No. 11, 2005, pp. 647-652. doi:10.1007/s00204-005-0674-4
- [17] G. Rock, R. Labow and M. Tochi, " Distribution of Di(2-ethyl hexyl) Phthalates and Products in Blood and Blood Components," *Environmental Health Perspectives*, Vol. 65, 1986, pp. 309-316.
- [18] F. Zeng, K. Cui, A. Xie, M. Liu and Y. Li, " Occurrence of Phthalate Esters in Water and Sediment of Urban Lakes in a Subtropical City, Guangzhou South China," *Environment International*, Vol. 34, No. 3, 2008, pp. 372- 380.
- [19] T. L. Swan and J. Davis, " Mechanisms of Phthalate Esters Toxicity in the Female Reproductive System," *Environmental Health Perspectives*, Vol. 11, 2003, pp. 139- 145.
- [20] O. S. Fatoki and A. Noma, " Solid Phase Extraction Method for Selective Determination of Phthalate Esters in the Aquatic Environment," *Water, Air & Soil Pollution*, Vol. 140, No. 1-4, 2002, pp. 85-98. doi:10.1023/A:1020134707450
- [21] W. W. Huber, B. Crasl-Kraupp and R. Schulte-Hermann, " Hepatocarcinogenic Potential of DEHP in Rodents and Its Implications on Human risk," *Critical Review in Toxicology*, Vol. 26, 1996, pp. 365-481.

- [22] J. Vessman, and G. Reitz, " Determination of Di(ethylhexyl) Phthalate in Human: Plasma and Plasma Proteins by Electron Capture Gas Chromatography," *Journal of Chromatography*, Vol. 100, No. 1, 1974, pp. 153-163. doi:10.1016/S0021-9673(00)86049-5
- [23] M. J. Bauer and R. Herrmann, " Estimation of the Environmental Contamination by Phthalic Acid Esters Leaching from Household Wastes," *Science of the Total Environment*, Vol. 208, No. 1-2, pp. 49-57. doi:10.1016/S0048-9697(97)00272-6
- [24] A. O. Ogunfowokan, N. Torto, A. A. Adenuga and E. K. Okoh, " Survey of Level of Phthalate Ester Plasticizers in a Sewage Lagoon Effluent and a Receiving Stream," *Environmental Monitoring and Assessment*, Vol. 118, No. 1-3, 2006, pp. 457-480. doi:10.1007/s10661-006-1500-z
- [25] O. S. Fatoki and A. O. Ogunfowokan, " Procedural Clean-Up Technique for Determination of Phthalate Esters in an Aquatic Environment," *International Journal of Environmental Studies*, Vol. 44, No. 4, 1993, pp. 237-243. doi:10.1080/00207239308710864
- [26] O. S. Fatoki and A. O. Ogunfowokan, " Determination of Phthalate Ester Plasticizers in the Aquatic Environment of South Western Nigeria," *Environment International*, Vol. 19, No. 3, 1993, pp. 619-623. doi:10.1016/0160-4120(93)90314-8
- [27] M. Vitali, M. Guidotti, G. Macilenti and C. Cremisini, " Phthalate Esters in Freshwaters as Markers of Contamination Sources: A Site Study in Italy," *Environment International*, Vol. 23, No. 3, 1997, pp. 337-347. doi:10.1016/S0160-4120(97)00035-4
- [28] A. Bjorseth, J., Knutzen and J. Skei, " Determination of Polycyclic Aromatic Hydrocarbons in Sediments and Mussel from Saudafjord, W. Norway, by Glass Capillary Gas Chromatography," *Science of the Total Environment*, Vol. 13, 1979, pp. 71-89. doi:10.1016/0048-9697(79)90018-4
- [29] G. Park and F. Poole, " Solvation in Weak Complexing n-Octyl Phthalate and n-Octylterachlorophthalate Solvent by Gas Chromatography," *Journal of Chromatography A*, Vol. 726, No. 1-2, 1996, pp. 141-151. doi:10.1016/0021-9673(95)01061-0
- [30] K. Sreenivasan, " Effect of Blending  $\beta$ -Cyclodextrin with Poly(vinyl chloride) on the Leaching of Phthalate Ester of Hydrophilic Medium," *Journal of Applied Polymer Science*, Vol. 95, No. 13, 1998, pp. 2089-2093.
- [31] V. Kuma and T. Y. Yang, " Interpolymer Complexation: Preparation and Characterization of a Polyvinyl Acetate Phthalate-Polyvinyl Pyrrolidone (PVAP-PVP) Complex," *International Journal of Pharmaceutics*, Vol. 188, No. 2, 1999, pp. 221-232. doi:10.1016/S0378-5173(99)00223-9