ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 10, Issue, 09, pp.73739-73742, September, 2018
DOI: https://doi.org/10.24941/ijcr.32085.09.2018

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

ASSESSMENT OF POLYCYCLIC AROMATIC HYDROCARBON CONCENTRATION IN SOME VEGETABLES IN RIVERS STATE, NIGERIA

[1,*]Onuoha, S.C. and [2]Karibo, O.

[1]Department of Biochemistry, Faculty of Science, University of Port Harcourt, P.M.B 5323, Choba, Rivers State, Nigeria
[2]Department of Medical Biochemistry, Faculty of Basic Medical Sciences, University of Port Harcourt, Choba, Rivers State, Nigeria

ARTICLE INFO

Article History:
Received 29th June, 2018
Received in revised form 20th July, 2018
Accepted 15th August, 2018
Published online 30th September, 2018

Key Words:
PAHs, Vegetables, Contamination, Rumuosi, Choba.

ABSTRACT

Polycyclic aromatic hydrocarbons (PAHs) have received great attention due to their potential adverse human health and ecosystem impacts. PAHs can readily be adsorb by plants via particulate organic matter such as soil sediments. This study evaluates the concentration of PAHs in vegetables in Rumuosi and Choba, Port Harcourt Metropolis, Rivers State, Nigeria. A total component of PAHs measure in Rumuosi and Choba were within of 9 – 16, 10 – 12 and 14 – 15 for water leaf, pumpkin and bitter leaf, respectively. Average concentrations of PAHs for water leaf, pumpkin and leaf ranged from 8.0E-5 – 1.03E-2, 3.0E-5 – 1.02E-2 and 6.0E-6 – 1.28E-2 mg/kg wet wt. respectively. The concentration of PAHs in the vegetables from Rumuosi were in the following ascending order: Pumpkin >bitter leaf > water leaf, whereas in Choba, they were in following ascending order: water leaf > bitter leaf > pumpkin. The results indicate that PAHs concentrations in vegetables from Rumuosi and Choba are high and, thus, consumption of these vegetables may pose significant health risk to the populace who consume them on a regular basis. The communities in the study area should take a proactive and public stand against individuals who engage in illegal activities such as combustion of hydrocarbon materials, bunkering and artisanal refining. These activities result in a huge environmental footprint, seriously impacting livelihood and public health.

Citation: ***Onuoha, S.C. and Karibo, O.*** **2018.** "Assessment of polycyclic aromatic hydrocarbon concentration in some vegetables in rivers state, Nigeria", *International Journal of Current Research*, 10, (09), 73739-73742.

INTRODUCTION

Polycyclic aromatic hydrocarbons (PAHs) have received great attention due to their potential adverse human health and ecosystem impacts. Human environmental exposure to these pollutants can cause cancer, mutations and birth defects (Nkpaa *et al*., 2013). PAHs adverse health effects have also been implicated in marine organism's destruction and this include endocrine alteration (Meador *et. al*., 2006), malformations of embryo and larvae (Carls *et. al*., 2008; Camus and Olsen, 2008) and growth reduction (Christiansen and George, 1995), and DNA damage (Caliani *et. al*., 2009). It has been reported that human ingestion of contaminated food (Meador *et. al*., 2006) and inhalation in air are the major routes of PAHs exposure in humans (Nkpaa *et al*., 2013).

Corresponding author: **Onuoha, S.C.**
Department of Biochemistry, Faculty of Science, University of Port Harcourt, P.M.B 5323, Choba, Rivers State, Nigeria
DOI: https://doi.org/10.24941/ijcr.32085.09.2018

Due to the lipophilic nature and high chemical stability of PAHs (Bouloubassi *et. al*., 2001), they tend to bio-accumulate in the fatty tissues of the body following their uptake (Van der Oost *et. al*., 1991) via water and vegetables. Also, vegetables may represent a good indicator of pollution in the sampling communities, and they have been used extensively for environmental monitoring (Bouloubassi *et al*., 2001; Bouloubassi *et. al*., 2006; and Nyarko, *et. al*., 2011). A large percentage of the world's population depends on seafood, especially vegetable for food, to meet their nutritional requirements. In southern Nigeria, vegetable is recognized as one of the important source of plant protein, and provides over 30 % protein intake (Nkpaa *et al*., 2013). Food consumption has been identified as an important pathway of human exposure to many contaminants including PAHs and heavy metals (Cheung *et al*., 2007, Nkpaa *et al*., 2016, 2017) and, therefore, PAHs contamination of vegetables that are widely consumed among the population may have serious health implications.

Therefore, this study assesses the polycyclic aromatic hydrocarbon concentration in some vegetables in Rivers State, Nigeria

MATERIALS AND METHODS

Study area: Rumuosi and Choba has a tragic history of pollution from vehicle congestion as oil well fires; although no systematic scientific information has been available about the ensuing contamination.

Collection of test samples processing: Fresh samples of vegetables were collected from different farmlands. At each site, bitter leaf, water leaf and pumpkin leaf of similar size of each species were collected, cleaned and wrapped in aluminum foils, then kept frozen in an ice chest before transported to the laboratory for analysis.

Processing of vegetables and analysis: The vegetables samples were dried in an oven for 144h and pulverized with blender (National, MX 795N, Japan) and kept in air tight containers prior to extraction process. Two grams (2g) of sample were weighed into a clean extraction container (50ml beaker) and 10ml of dichloromethane (extraction solvent) was added into the sample and thoroughly mixed and allowed to settle. The sample was carefully filtered into clean solvent rinsed extraction bottle, using filter paper fitted into Buchner funnels. The extract was concentrated to 2 ml and then transferred for cleanup/separation.

Cleanup/separation: One (1cm) of moderately packed glass wool was placed at the bottom of 10mm ID * 250mm Loup chromatographic column. Slurry of 2g activated silica in 10ml methylene chloride was prepared and placed into the chromatographic column. To the top of the column was added 0.5cm of sodium sulphate. The column was rinsed with additional 10ml methylene chloride and pre-eluted with 20ml of dichloromethane. This was allowed to flow through the column at a rate of about 2minutes until the liquid in the column was just above the sulphate layer. Immediately 1ml of the extracted samples was transferred into the column. The extraction bottle was rinsed with 1ml of dichloromethane and added to the column as well. The stop clock of the column was opened and the element was collected with a 10ml graduated cylinder. Just prior to exposure of the sodium sulphate layer to air, dichloromethane was added to the column in 1 – 2 increments. Accurately measured volume of 8 – 10ml of the eluent was collected and labeled (Nkpaa *et al*., 2013).

Gas Chromatography Analysis: The concentrated aliphatic fractions were transferred into labeled grass vials with rubber clip cap for gas chromatography analysis. 1µl of the concentrated sample was injected by means of hypodermic syringe through a rubber septum into the column. Separation occurred at the vapor constituent partition between the gas and liquid phase. The sample was automatically detected as it emerges from the column (at constant flow rate) by the flame ionization detector (FID) detector whose response is dependent upon the composition of the vapor (Nkpaa *et al*. 2013).

Chromatographic conditions: The gas chromatography was Hewlett Packed 5890 series II, gas chromatography apparatus, coupled with flame ionization detector (FID) (Hewlett Packard, Wilmington, DE, USA), powered with HP chemstation Rev. A 09:01 (10206) software to identify and quantify compounds. The GC operating conditions were as specified by the procedural manual (Nkpaa *et al*., 2013).

Statistical analysis: Statistical significance was assessed using a one-way analysis of variance (ANOVA). Comparisons of PAHs levels between species within sites were made using student t-test while one-way analysis of variance (ANOVA) was performed to compare PAHs levels between species across sites with the statistical package SPSS 14.0.2 (SPSS Inc., Chicago, USA).

RESULTS

The average and total concentrations of polycyclic aromatic hydrocarbons (PAHs) (mg/kg wet wt.) are presented in Table 1. A total of 9 and 16 PAHs were analyzed for in waterleaf from Rumuosi and Choba, respectively. Average concentrations of these PAHs ranged from 8.0E-5 to 1.03E-2 mg/kg wet wt, with a total PAHs of 1.25E-2 and 3.45E-2 for waterleaf in Rumuosi and Choba, respectively. Waterleaf had a highest value of 4.0E-3 for fluoranthene and 1.03E-2for benzo[a]anthracene in Rumuosi and Choba, respectively. Also, a total of 10 and 12 PAHs were analyzed for in pumpkin from Rumuosi and Choba, respectively. Average concentrations of these PAHs ranged from 3.0E-5 to 1.02E-2 mg/kg wet wt, in Rumuosi and ranged from 1.0E-5 to 1.6E-3 mg/kg wet weight in Choba, with a total PAHs of 6.65E-2 and 6.88E-3 for pumpkin in Rumuosi and Choba, respectively. Pumpkin had a highest value of 1.02E-2 for benzo[a]anthracene and 1.6E-2 for phenanthrene in Rumuosi an Choba, respectively. Moreover, a total of 14 and 15 PAHs were analyzed for in bitterleaf from Rumuosi and Choba, respectively. Average concentrations of these PAHs ranged from 6.0E-6 to 1.28E-2 mg/kg wet weight, in Rumuosi and ranged from 1.0E-5 to 3.4E-3 mg/kg wet weight in Choba, with a total PAHs of 1.28E-2 and 1.09E-2 for bitter leaf in Rumuosi and Choba, respectively. Bitter leaf had a highest value of 1.02E-2 for fluorene and 3.4E-2 for benzo[a]anthracene in Rumuosi an Choba, respectively. The concentration of PAHs in the vegetables from Rumuosi were in the following ascending order: Pumpkin > bitter leaf > water leaf, whereas in Choba, they were in following ascending order: water leaf > bitter leaf > pumpkin.

DISCUSSION

Exposure pathways of PAHs for food include bio-concentration from soil and ingestion of PAH-contaminated particulate matter along with food (Meador *et al*., 2006). PAHs can readily be adsorb by plants via particulate organic matter such as soil sediments (Raoux *et. al*., 1999). Possible anthropogenic sources of PAHs include combustion of petroleum, automobile tire, and wood and vehicle emission. PAHs may then be transported from their points of release to the coastal environment via surface runoff and atmospheric deposition (Lipiatou and Saliot, 1991). The measure PAHs in all the vegetables were significantly higher above permissible limit of PAHs allowed in food crops (USEPA, 2000). The presence and bio-concentration of PAHs in these vegetables is a serious matter of concern in the study sites. The presence of PAHs in these vegetables is possibly due to the high rate of hydrocarbon combustion present in the study area and local physical mixing, which can result in re- suspension of bottom sediments and redistribution of PAHs in the environment (Jurado *et. al*., 2007), thereby, exposing vegetables to PAHs.

Table 1. The concentration of individual polycyclic aromatic hydrocarbons (PAHs) (mg/kg) in pumpkin leaf, bitter leaf, and water leaf samples collected from different location of Rivers State, Nigeria

PAHs concentration	Waterleaf		Pumpkin		Bitter leaf	
	Rumuosi	Choba	Rumuosi	Choba	Rumuosi	Choba
Naphthalene	ND	1.42E-3	4.0E-3	2.0E-4	ND	ND
2- methyl Naphthalene	ND	1.9E-3	ND	1.0E-5	6.0E-6	7.0E-4
Acenapthylene	ND	5.3E-4	ND	ND	6.0E-4	7.1E-5
Acenapthene	ND	8.0E-4	ND	ND	ND	3.0E-5
Fluorene	ND	2.0E-3	ND	ND	1.0E-2	1.0E-5
Phenanthrene	ND	1.03E-2	ND	1.6E-3	2.0E-4	8.0E-5
Anthracene	ND	1.2E-3	ND	ND	7.0E-4	2.0E-3
Fluoranthene	4.0E-3	2.5E-3	3.0E-5	1.5E-3	1.3E-4	1.0E-3
Pyrene	1.0E-3	7.5E-4	4.0E-4	1.5E-4	5.0E-4	1.1E-3
Benz [a] anthrancene	2.4E-3	2.03E-3	1.02E-2	5.9E-4	2.1E-4	3.4E-3
Chrysene	8.0E-5	1.12E-3	3.3E-4	4.0E-5	5.0E-5	1.3E-3
Benzo [b] fluoranthene	3.3E-3	3.0E-3	4.0E-2	1.6E-3	1.5E-5	5.0E-5
Benzo [k] fluoranthene	3.1E-4	6.0E-3	2.2E-3	4.0E-5	6.0E-6	4.0E-4
Benzo [a] pyrene	5.0E-4	4.0E-4	1.2E-3	1.5E-4	3.0E-4	4.0E-4
Indeno [1,2,3-cd] pyrene	5.0E-4	1.0E-4	5.0E-3	2.0E-4	3.0E-5	3.0E-4
Dibenz [a,h] anthracene	4.0E-4	2.0E-4	3.1E-3	8.0E-4	1.2E-5	4.0E-5
Total PAHs	1.25E-2	3.45E-2	6.65E-2	6.88E-3	1.28E-2	1.09E-2

The observed differences in PAH bio-concentration in the vegetables may be attributed to differences in bio-concentration rate of the different vegetables feeding. The levels of concentrations of contaminants such as PAHs in environmental media may reflect the state of contamination of the environment (Lanfranchi *et. al*., 2006) and, therefore, the observed levels of total PAHs in the vegetables in this study indicate high levels of PAH contamination in Rumuosi and Choba. PAHs are also known to cause adverse health effect such as endocrine alteration (Meador *et al*., 2006), growth reduction (Christiansen and George, 1995), cancer, mutations and birth defects and DNA damage (Caliani *et. al*., 2009) in human. This result is important to the Government regulatory agencies due to fact that the population living around the study areas may be exposed to substantial levels of PAHs in commonly consumed vegetables.

Conclusion

The study has established that PAHs concentrations measured in the vegetables from Rumuosi and Choba are high and, thus, consumption of these vegetables may pose significant health risk to the populace who consume them on a regular basis. The communities in the study area should take a proactive and public stand against individuals who engage in illegal activities such as combustion of hydrocarbon materials, bunkering and artisanal refining. These activities result in a huge environmental footprint, seriously impacting livelihood and public health.

REFERENCES

Bouloubassi, I., Fillaux, J. and Saliot A. 2001. Hydrocarbons in surface sediments from Changjian (Yangtze River) estuary, East China Sea. *Mar. Pollut. Bull*., 42: 1335–13462.

Bouloubassi, I., Mejanelle, L., Pete, R., Fillaux, J., Lorre, A. and Point, V. 2006. Transport by sinking particles in the open Mediterranean Sea: a 1-year sediment trap study. *Mar. Pollut. Bull*., 52: 560–571.

Caliani, I., Porcelloni, S., Mori, G., Frenzilli, G., Ferraro M., Marsili, L., Casini, S. and Fossi, M. C. 2009. Genotoxic effects of produced waters in mosquito fish (Gambusia affinis). Ecotoxicology 18: 75-80.

Camus, L. and Olsen, G. H. 2008. Embryo aberrations in sea ice amphipod (Gammaruswilkitzkii) exposed to water soluble fraction of oil. *Mar. Envir. Res*., 66: 221–222.

Carls, M. G., Holland, L., Larsen, M., Collier, T. K., Scholz, N. L. and Incardona, J. P. 2008. Fish embryos are damaged by dissolved PAHs, not oil Particles. *Aquat. Toxicol*. 88, 121-127.

Cheung, K. C., Leung, H. M., Kong, K. Y. and Wong, M. H. 2007. Residual levels of DDTs and PAHs in freshwater and marine fish from Hong Kong markets and their health risk assessment. *Chemosphere*, 66: 460–468.

Christiansen, J. S. and George, S. G. 1995. Contamination of food by crude oil affects food selection and growth performance, but not appetite, in an Arctic fish, the polar cod (Boreogadus

Jurado, E., Zaldivar J. M., Marinov, D. and Dachs, J. 2007. Fate of persistent organic pollutants in the water column: does turbulent mixing matter? *Mar. Pollut. Bull*., 54: 441–451.

Lanfranchi, A. L., Menone, M. L., Miglioranza, K. S. B., Janiot, L. J., Aizpu, J. E. and Moreno, V. J. 2006. Striped weakfish (Cynoscion guatucupa): a biomonitor of organo chlorine pesticides in estuarine and nearcoastal zones. *Mar. Pollut. Bull*., 52: 74–80.

Lipiatou, E. and Saliot, A. 1991. Fluxes and transport of anthropogenic and natural polycyclic aromatic hydrocarbons in the western Mediterranean Sea. *Mar. Chem*., 32: 51–75.

Meador, J. P., Sommers, F. C., Ylitalo, G. M. and Sloan, C. A. 2006. Altered growth and related physiological responses in juvenile Chinook salmon (Oncorhynchus tshawytscha) from dietary exposure to polycyclic aromatic hydrocarbons (PAHs). *Can. J. Fish. Aquat. Sci.*, 63: 2364-2376.

Nkpaa, K.W., Onyeso, G.I., Achugasim, O. 2017. Heavy metals levels in shellfish from Bodo City and B-Dere, Ogoniland, Rivers State, Nigeria, and evaluation of possible health risks to consumers. Sustain. Water Resour. Manag. 3:83–91

Nkpaa, K.W., Patrick-Iwuanyanwu, K.C., Wegwu, M.O., Essien, E.B., 2016. Health risk assessment of hazardous metals for population via consumption of seafood from Ogoniland, Rivers State, Nigeria; a case study of Kaa, B-Dere, and Bodo City. *Environmental Monitoring and Assessment*, 188(9).

Nkpaa, K.W., Wegwu, M.O., Essien, E.B. 2013. Assessment of Polycyclic Aromatic Hydrocarbons (PAHs) Levels in Two Commercially Important Fish Species from crude oil polluted Waters of Ogoniland and Their Carcinogenic Health Risks. *Journal of Environment and Earth Science*, 3:128-137.

Nyarko, E., Botwe, B.O. and Klubi E. 2011. Polycyclic Aromatic Hydrocarbon (PAHs) Levels in Two Commercially Important Fish Species from the Coastal Waters of Ghana and their Carcinogenic Health Risks, *West African Journal of Applied Ecology,* vol. 19

Raoux, C., Bayona, J. M., Miquel, J. C., Teyssie, J. L., Fowler, S. W. and Labaies, J. 1999. Particulate fluxes of aliphatic and aromatic hydrocarbons in near shore waters to the north-western Mediterranean Sea, and the effect of continental runoff. Estuar. *Coast. Shelf Sci.,* 48: 605–616.

Saida. Polar Biol. 15: 277–281. Effenga Archibong and Aramandla Ramesh (2009). Comparative metabolism of benzo (a) pyrene by ovarian microsomes of various species. Environ Toxicol. 2009:24(6):603-609.

USEPA, 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, EPA/823/B-00/007, United States Environmental Protection Agency.

Van der Oost, R., Heida, H., Opperhuizen, A. and Vermeulen, P. E. 1991. Interrelationships between bioaccumulation of organic trace pollutants (PCBs, organochlorine pesticides and PAHs, and MFO-induction in fish. *Comp. Biochem. Physiol.,* 100: 43-47.

****