Global Scientific JOURNALS

GSJ: Volume 7, Issue 6, June 2019, Online: ISSN 2320-9186
www.globalscientificjournal.com

DETERMINATION OF PAHs CLOSE TO- AND AWAY-FROM A MAJOR SLAUGHTER IN YENAGOA METROPOLIS IN BAYELSA STATE

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Abstract

PAHs can be produced by burning such materials as coal, oil or trash asphalt among others. These PAHs can be carried by dust to un-imaginable long distances. In Yenagoa, several burning activities take place and these are possible sources of PAHs. The present work was designed to determine the concentration of PAHs in settled dust around and away from a slaughter; the largest and busiest slaughter at Swali Market, Yenagoa Metropolis, Bayelsa State, was chosen for the study. Settled dust samples were collected in plastic basins, prepared and analyzed by GC-MS; samples were collected at the centre of the slaughter, 100 meters away from slaughter, 200 meters away from slaughter and they were respectively designated A, B, and C. The results for the different PAHs are as follows: Naphthalene, (Sample A, 276.007 sample B, 272.113; sample C, 276.007), Acenaphthylene (Sample A, 259.561 sample B, 254.022 ; sample C, 259.561), Acenaphthene (Sample A, 95.897 sample B, 89.1218 ; sample C, 95.897), Fluorene (Sample A, 495.085 sample B, 504.549 ; sample C, 495.085), Phenanthrene (Sample A, 268.417 sample B, 261.037 ; sample C, 268.417), Anthracene (Sample A, 135.546 sample B, 119.140 ; sample C, 135.546), Fluoranthene (Sample A, 71.417 sample B, 69.863 ; sample C, 71.417), Pyrene (Sample A, 362.956 sample B, 334.177 ; sample C, 362.956), Benzo(a)anthracene (Sample A, 140.801 sample B, 144.409 ; sample C, 140.801), Chrysene (Sample A, 76.919 sample B, 71 .000 ; sample C, 76.919), Benzo(b)fluoranthene (Sample A, 73.686 sample B, 62.668 ; sample C, 73.686). The results show no significant differences between sample around and away from the slaughter; suggesting that the slaughter under investigation contributes little or no PAHs to the environment.

Keywords: PAHs, slaughter, GC-MS, settled dust, burning

INTRODUCTION

Polycyclic aromatic hydrocarbons (PAHs) are hydrocarbon organic compounds containing only carbon and hydrogen that are composed of multiple aromatic rings (organic rings in which the electrons are delocalized formally) [1].

PAHs can be found in petrochemicals, rubbers, plastics, lubricants, antirust oil, paints, leather and other product. They are natural and man-made chemicals created when materials like coal, oil or trash are burned. Because they break down slowly, PAHs are used to make dyes, plastics, pesticides, asphalt and other products [2, 3].

PAHs, another important group of environmental contaminants have been widely detected in soil, industrial effluent, marine bottom sediments, air, meat and sea food. Little research have been conducted, however to evaluate the PAHs contamination in dust, especially in indoor dust which can easily become the carrier of pollutants, directly or indirectly by human; [4, 5, 6, 7, 8, 9, 10].

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Inhalation or ingestion can induce a variety of diseases. The exposure through ingestion and inhalation of dust may be comparable to corresponding food consumption, especially for younger children [11]. Cancer is a primary human risk from exposure to PAHs. One of the sources of PAHs in the environment is the burning of materials and in the Yenagoa metropolis, burning activities are very common in slaughters; such burning activities include burning of animal furs (preparation of meat), and the burning of solid wastes. The aim of this work was to determine PAHs in settled dust (collected close to- and away-from a designated slaughter) in order to assess whether the burning activities are capable of causing localized increase in the level of PAHs around such areas (slaughters) where burning activities are common.

MATERIALS AND METHODS

Dust Sampling and Preparation

Three dust samples were collected in three locations in Yenagoa (labeled sample A, sample B, and sample C) using a stainless plate placed above the ground level where dusts accumulates easily to prevent cross contamination. The samples were collected in triplicate; morning, afternoon and evening. samples were collected at the centre of the slaughter, 100 meters away from slaughter, and 200 meters away from slaughter and they were respectively designated A, B, and C.

Samples were collected at different times of the day to correct for possible variability caused by wind flow direction.

All dust samples were collected with stainless plates to prevent cross contamination, the plates were cleaned between samples by ultrasonic rinsing in water for 5 minutes, rinsed with deionized water 3 times and then air dried. The dust samples were brought to the laboratory and placed in a desiccator for 48 hours, sieved through 80 µm screen and finally oven dried at 45^{o}C.

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Sample Preparation and Analysis

Dust samples were dried by a controllable temperature oven (45℃). 10 mL of dichloromethane was added to 1 gram of each of the three dust samples and then placed in an ultrasonic bath. The mixture was kept for 72 hours (3 days) and then decanted. The decanted solution was centrifuged for 10 minutes and filtered and the filtrate was used for gas chromatography analysis (GC-MS).

Chromatographic Analysis of PAHs in Dust

The samples were analyzed with GC-MS. The equipment was standardized and calibrated by injecting about 2µL mixture of PAHs.

A capillary column (25 m by 25 µm id, film thickness 0.25 µm) was used and helium gas was used as the carrier gas after an initial holding time of five min. The oven temperature was increased from 45℃ to 120℃ at a rate of 10℃/min then to 150℃ to 6℃/min. Helium was used as carrier gas at a constant flow rate of 45mL min-1. The bake time was 8 min at 260℃. The split ratio was 1:40 and the injection and detection temperature were maintained at 250℃ and 280℃ respectively.

RESULTS AND DISCUSSION

The GC-MS chromatograms of sample A, B, and C are respectively shown in Figures 1, 2, and 3. The average concentration of the PAHs are shown in Table 1. Tables 2 and 3 respectively show the statistical analytical results of samples A and B, samples B and C. The PAHs identified in the chromatograms were naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene.

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The results for the different PAHs are as follows: Naphthalene, (Sample A, 276.007 sample B, 272.113; sample C, 276.007), Acenaphthylene (Sample A, 259.561 sample B, 254.022 ; sample C, 259.561), Acenaphthene (Sample A, 95.897 sample B, 89.1218 ; sample C, 95.897), Fluorene (Sample A, 495.085 sample B, 504.549 ; sample C, 495.085), Phenanthrene (Sample A, 268.417 sample B, 261.037 ; sample C, 268.417), Anthracene (Sample A, 135.546 sample B, 119.140 ; sample C, 135.546), Fluoranthene (Sample A, 71.417 sample B, 69.863 ; sample C, 71.417), Pyrene (Sample A, 362.956 sample B, 334.177 ; sample C, 362.956), Benzo(a)anthracene (Sample A, 140.801 sample B, 144.409 ; sample C, 140.801), Chrysene (Sample A, 76.919 sample B, 71 .000 ; sample C, 76.919), Benzo(b)fluoranthene (Sample A, 73.686 sample B, 62.668 ; sample C, 73.686).

Considering the analyses data and statistical results (Tables 2 and 3), the PAHs could probably originate from activities such as vehicular emissions, coal burning, that take place around all sampling sites. And there were no

significant differences between sites close to slaughter and away from slaughters; suggesting that specific burnings that take place at slaughters may not have contributed significantly to the level of PAHs in the Yenagoa Metropolis.

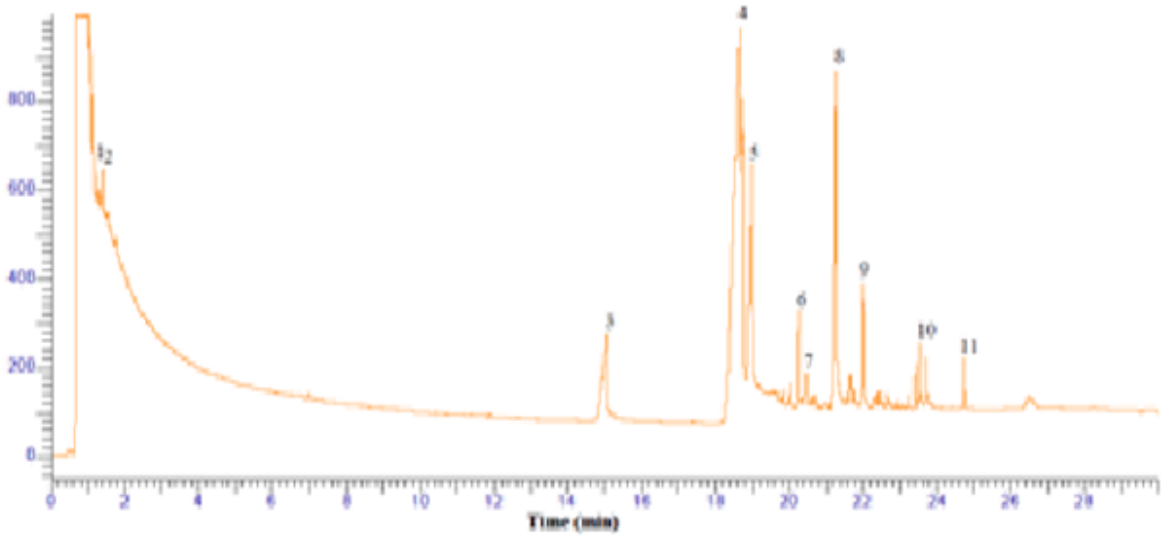

Figure 1. Chromatogram of Sample A (designated "close to slaughter"). 1 = Naphthalene, 2 = Acenaphthalene, 3 = Acenaphthene, 4 = Fluorene, 5 = Phenanthrene, 6 = Anthracene, 7 = Fluoranthene, 8 = Pyrene, 9 = Benzo [a] anthracene, 10 = Chrysene, 11 = Benzo [b] fluoranthene

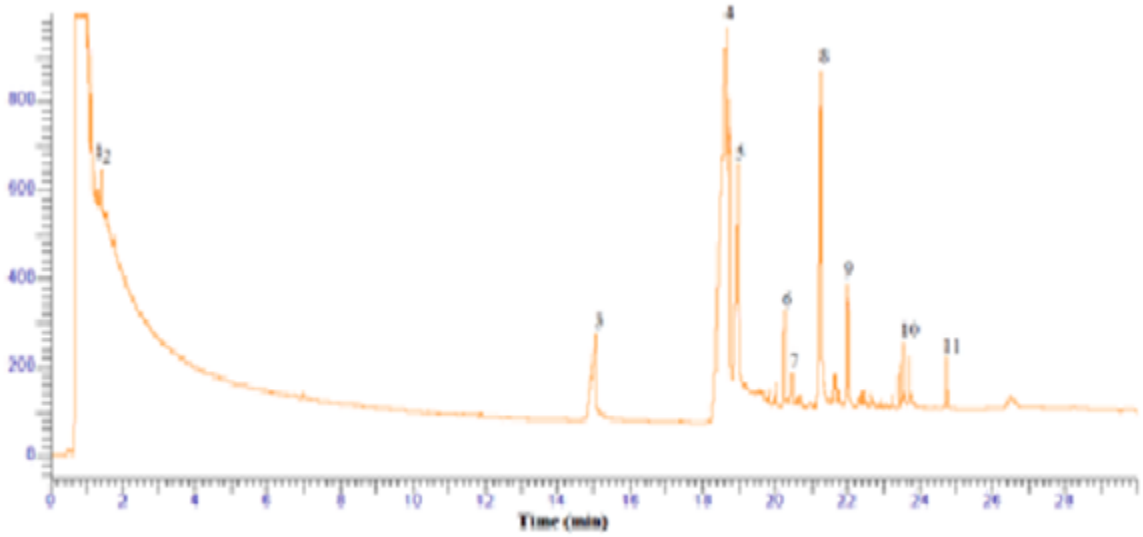

Figure 2. Chromatogram of Sample B (designated 100 meter away from slaughter).
1 = Naphthalene, 2 = Acenaphthylene, 3 = Acenaphthene, 4 = Fluorene, 5 = Phenanthrene
6 = Anthracene, 7 = Fluoranthene, 8 = Pyrene, 9 = Benzo [a] anthracene, 10 = Chrysene
11 = Benzo [b] fluoranthene

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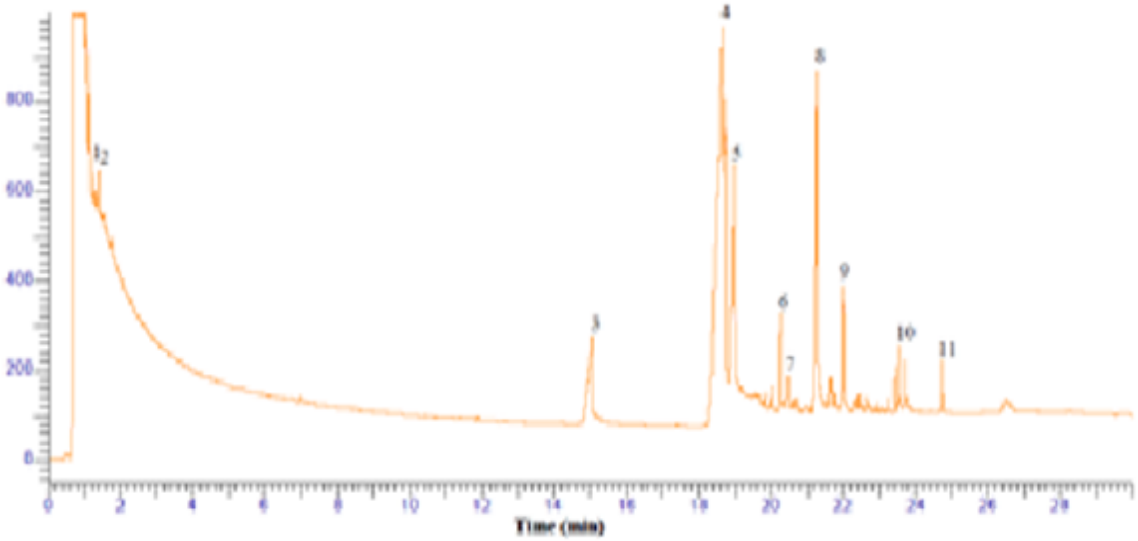

Figure 3. Chromatogram of Sample B (designated 200 meter away from slaughter).
1 = Naphthalene, 2 = Acenaphthylene, 3 = Acenaphthene, 4 = Fluorene, 5 = Phenanthrene
6 = Anthracene, 7 = Fluoranthene, 8 = Pyrene, 9 = Benzo [a] anthracene, 10 = Chrysene
11 = Benzo [b] fluoranthene

Table 1. Concentration of components

Analyte	Concentration in ppb		
	Sample A	Sample B	Sample C
Naphthalene	276.007 ± 0.09	275.113 ± 0.02	276.007 ± 0.02
Acenaphthylene	259.561 ± 0.01	254.022 ± 0.03	259.561 ± 0.02
Acenaphthene	95.897 ± 0.08	89.1218 ± 0.07	95.897 ± 0.02
Fluorene	495.085 ± 0.01	504.549 ± 0.06	495.085 ± 0.01
Phenanthrene	268.417 ± 0.07	261.037 ± 0.098	268.417 ± 0.03
Anthracene	135.546 ± 0.02	119.140 ± 0.02	135.546 ± 0.05
Fluoranthene	71.417 ± 0.03	69.863 ± 0.06	71.417 ± 0.04
Pyrene	362.956 ± 0.01	334.177 ± 0.08	362.956 ± 0.01
Benzo(a)anthracene	140.801 ± 0.04	144.409 ± 0.06	140.801 ± 0.03
Chrysene	76.919 ± 0.01	71 .000 ± 0.02	76.919 ± 0.01
Benzo(b)fluoranthene	73.686 ± 0.06	62.668 ± 0.07	73.686 ± 0.09

Table 2. Statistical analytical results of sample A and B

Nutrient	Habitat	N	Sig (2-tailed), $p < 0.05$
Naphthalene	Location A	5	0.08
	Location B	5	
Acenaphthylene	Location A	5	0.06
	Location B	5	
Acenaphthene	Location A	5	0.05
	Location B	5	
Fluorene	Location A	5	0.06
	Location B	5	
Phenanthrene	Location A	5	0.06
	Location B	5	
Anthracene	Location A	5	0.08
	Location B	5	
Fluoranthene	Location A	5	0.09
	Location B	5	
Pyrene	Location A	5	0.08
	Location B	5	
Benzo(a)anthracene	Location A	5	0.06
	Location B	5	
Chrysene	Location A	5	0.07
	Location B	5	
Benzo(b)fluoranthene	Location A	5	0.05
	Location B	5	

N = number of replicate samples

Table 3. Statistical analytical results of sample B and C

Nutrient	Habitat	N	Sig (2-tailed), p < 0.05
Naphthalene	Location B	5	0.05
	Location C	5	
Acenaphthylene	Location B	5	0.05
	Location C	5	
Acenaphthene	Location B	5	0.09
	Location C	5	
Fluorene	Location B	5	0.08
	Location C	5	
Phenanthrene	Location B	5	0.08
	Location C	5	
Anthracene	Location B	5	0.08
	Location C	5	
Fluoranthene	Location B	5	0.07
	Location C	5	
Pyrene	Location B	5	0.05
	Location C	5	
Benzo(a)anthracene	Location B	5	0.05
	Location C	5	
Chrysene	Location B	5	0.05
	Location C	5	
Benzo(b)fluoranthene	Location B	5	0.05
	Location C	5	

N = number of replicate samples

CONCLUSION

The mean of the concentrations of PAHs in samples A, B, and C and the statistical analyses show no significant differences in PAHs content of settled dust close to- and away-from the named slaughter. This means that the burning activities may be contributing little or no PAHs into the Yenagoa Metropolis.

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