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Polycyclic aromatic hydrocarbons in road dust over Greater Cairo, Egypt

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Abstract

Road dust samples were collected during 2005 and polycyclic aromatic hydrocarbons (PAHs) were determined. Sites under investigation were selected to represent the different parts of Greater Cairo, Egypt. Estimation and spatial distribution pattern of PAHs in road dust were the main objectives of this study. The road dust samples were collected from 17 sites over greater Cairo. The concentration of PAHs was determined by using HPLC technique. Twelve common environmental PAHs were found to be distributed. The present data illustrated that the total average of PAHs over the investigated sites was ranged from 0.045 to 2.6 mg/kg. On individual scale, the highest concentrations were 1.031 and 1.028 mg/kg for pyrene and phenanthrene, meanwhile the lowest was benzo(a)pyrene with value 0.0001 mg/kg. The obtained results showed that the carcinogenic content of PAHs (naphthalene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene and benzo(a)pyrene) ranged from 0.8 to 46.6% of total PAHs. It has been concluded from the present work that PAHs concentrations are greater and closer to traffic routes and industrial activities.

Keywords: Road dust; Greater Cairo; PAHs; Carcinogenic components; Potential risk

1. Introduction

Incomplete pyrolysis of organic materials from different urban sources is responsible for surface road dusts contamination with polycyclic aromatic hydrocarbons (PAHs) [1]. PAHs have been widely studied, as well known environmental pollutants, and an increasing particular concern has been paid to their adverse harmful effects to human due to the carcinogenic and mutagenic properties of many PAH species [2–7].

Sources of PAHs in environment, in the wider sense, include automobile exhaust, lubricating oils, atmospheric depositions, power plants, domestic heating systems, petrol and diesel engines, refuse burning and various industrial activities [8–17]. Most of PAH environmental burden is found in soil (≈95%), as opposed to air (≈0.2%) [18]. Concentrations of PAHs in street dust are assumed to be influenced by traffic density and rate of deposition [19–21]. Diesel vehicle exhaust, tire and pavement were confirmed to be the major contributors of PAHs in road dust in Japan [22,23]. Moreover, it has revealed that there was a significant difference in the PAH profiles between locations rather than between size-fractions and sampling times [22].

Most volatile compounds released from combustion process, in general, are either compounds with two or three aromatic rings, released mainly in the gas phase, or compounds containing three or more aromatic rings in their structure, associated with PM emission [24]. PAHs with four- to six-ring hydrocarbons are generally of pyrogenic origin [25].

PAHs concentration in road dust was found to vary according to the distance from the source of pollution [26]. For example, Butler et al. [27] have demonstrated much higher surface of road dust benzo(a)pyrene (BaP) concentrations near complex road interchanges than in areas of far distance. It was reported that concentrations of BaP ranged between 0.04 and 1.3 mg/kg in the soil or road dust from relatively rural areas of the eastern United States [28]. In this concern, Wild et al. [29] reported that concentrations of PAHs in UK soils are in the range of 0.1–54 mg/kg with a mean of 2.32 mg/kg. Moreover, Al-Haddad et al. [30] estimated the PAHs components in Bahrain soil and concentrations of various PAHs were found to fall within the range 0.01–42.58 mg/kg. Accumulation of PAHs in road dust

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should affect other media (e.g., air, drinking water, soil, dust and plants) and significant exposure risk for human populations is strongly expected [31–33].

Road dust PAHs was received relatively little attention in Egypt to date and most studies focused on heavy metals. Consequently, background level of PAHs in dust of Egyptian roads is not available. The major objective of the present study is to examine the distribution, concentration, profile and sources of PAHs in road dust along Greater Cairo.

2. Materials and methods

2.1. Greater Cairo description

Greater Cairo (30°08′N, 31°34′E) is the most populous region in Africa with about 15 million inhabitants. Geographically, the city is bordered from the east by the Mokattam Hills separating the city from the Eastern Desert and, to the east, the Abu-Rawash Hills and the Western Desert. Meteorologically, the region is a desert with an annual range of precipitation between 22–29 mm and temperatures between 18–45 °C. Winds prevailing in the area take the northern (N, NW and NE) direction 90% of the time for nine months of the year. The average wind speed, in general, increases significantly above 4 m s^{-1} during the winter period, which helps to reduce the ambient relative humidity in cooler weather relative to the summer period.

The population estimate for the greater Metropolitan area is about 15 million and the population density is 2361 per km^2. Cairo has had a dramatic growth in the number of vehicles. There are over 2,000,000 cars on the streets of Cairo, 60% of which are over 10 years old, and therefore lack modern emission cutting features like catalytic converters. Cairo has a very poor dispersion factor because of lack of rain and its layout of tall buildings and narrow streets, which create a bowl effect.

Cairo houses around 50–55% of the national industrial activity, most of which are belonging to the dominant public sector. The majority of these industrial facilities are distributed to the north (Shoubra El Khaima) and south (around Helwan) due to space availability, their close proximity to the Nile and to power generation facilities [34].

2.2. Description of sampling sites

Seventeen sampling sites were selected to represent different sectors in greater Cairo. Classification of sites, according to the main activity, is shown in Table 1. Sites 4 and 8 represent the heavily industrialized area in north Cairo, while Sites 3, 13, 14, 15 and 16 are located close to the major industrial area south Cairo. Despite of traffic activities in all sites, downtown sites (5, 6, 9 and 10), industrial and mixed sites (4 and 15) and residential sites (11, 13 and 16) are the most heavily traffic in this study. All residential sampling sites are high dense populated and characterized by the presence of several urban activities, including scattered vehicles service centers.

Table 1
Locations and character of sites over Greater Cairo

No.	Site	Character activity
1	Naser city	Residential
2	Salah Salem street	Traffic
3	South 15th May city	Traffic
4	Shobra El Kheima	Mixed area
5	Ramsis square	Traffic
6	Obera square	Traffic
7	Dar El Salam	Residential
8	El Warak	Mixed area
9	Dokki square	Traffic
10	Cairo University	Traffic
11	Giza square	Residential
12	Saft El Laban	Residential
13	Horia square El Maadi	Residential
14	El Maadi	Residential
15	El Maadi Autostrad	Traffic
16	El Basateen	Residential
17	Maruotya	Residential

2.3. Sampling

Road dust samples were collected from the 17 sampling areas chosen across Greater Cairo, Egypt (Fig. 1) during 2005. Road dust were sampled using sweeping tools and stored in hexane-washed aluminum foils at 25 °C. Initial sieving of the road dust content to remove hair, fibers and other particles greater than 2 mm in diameter was done. The samples were dried to constant weight, sieved through a 2-mm mesh and fractionated into different size fractions. Forty-five to one hundred and six micrometers size fraction was selected for analysis due to its largest weight proportion (39%), compared to other fractions, similar to Lewis et al. [35]; and coarse dust is more specific related to the activity of each area, according to the demonstration that large particles are deposited closer to their sources [36,37]. Each sample was moisture equilibrated for at least 8h in the desiccator and then weighed. After weighing, the road dust samples were extracted, concentrated, cleaned-up, and re-concentrated for the PAH analysis.

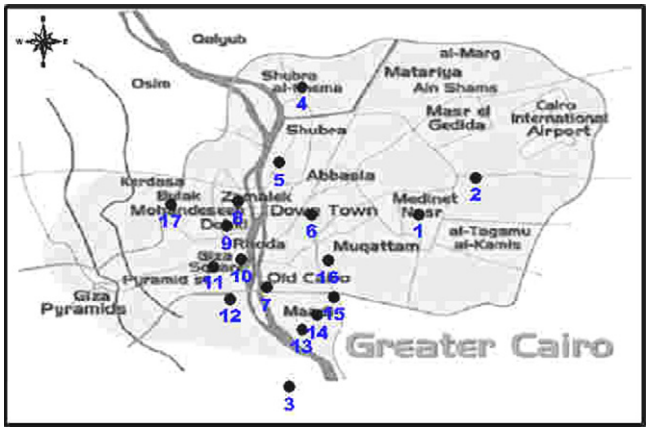

Fig. 1. Map of the Greater Cairo with location of road dust sampling sites (solid circles).

2.4. Polycyclic aromatic hydrocarbons analysis

Based on two successive steps, the method used for PAH analysis includes an organic solvent extraction and clean-up procedure [38,39]. Reagents and solvents used were highly purity Merck grade available.

2.4.1. Extraction

Fifty millilitres of acetone was added to 5 g dry road dust. Extraction was carried out by using ultrasonic extraction (Bransonic, model 2510) for 15 min followed by filtration. The extraction was repeated with 50 ml acetone, then 100 ml of petroleum ether (boiling range 40–60 °C) was added to the combined acetone extracts and the acetone and other polar components were removed by shaking twice with 400 ml portions of water. The remaining extract was dried over anhydrous sodium sulphate and transferred into a Kuderna-Danish concentrator to concentrate on a water bath to about 10 ml and finally to 1 ml by using a gentle stream of nitrogen at room temperature.

2.4.2. Clean-up

An adsorption column was prepared by weight 2 g of deactivated alumina and 1 cm of anhydrous sodium sulphate to the top of the column. The concentrated extract was dropped to the top of the column with a Pasteur pipette. The concentrator tube was rinsed twice with 1 ml of petroleum ether. Elution with 8 ml of petroleum ether and adding about 0.8 ml of acetonitrile, then concentrating at room temperature with a gentle stream of nitrogen until all petroleum ether has been removed, i.e until the volume of 0.8 ml has been reached.

2.4.3. Analysis and quality control

PAH components were determined by HPLC spectroscopy (Perkin Elmer LC-240 programmable, equipped with fluorescence detector). The certified mixed standard of parent PAH component was provided by Supleco Company (Mixture 610-M). The HPLC peaks were identified with the accurate assignment of retention time of PAHs' standards. Quantification of PAHs was based on the external calibration curves, and calculations of residual concentrations were expressed as the dry weight of road dust samples and corrected by the respective recoveries. The averaged recoveries for the studied PAH compounds were 80–99%.

For every set of 10 samples, a procedural blank, a spiked blank, a matrix spiked sample consisted of all chemicals, a matrix spiked replicate and a reference sample (obtained from EPA laboratory in Cincinnati) were run to check the interference, cross-contamination and minimize any errors due to losses during the extraction, cleaning, and concentration procedures. At least 20% replicates were examined to verify the precision of analytical results. In this study, 16 PAH species were considered according to the requirements of the survey program. Minimum detection limit was found to be 0.0001 mg/kg.

Significance of differences between levels of PAHs species found in different areas was performed by calculating Pearson's correlation coefficient using SPSS 11.0 for windows statistical package. A probability level of $p < 0.05$ was considered significant. The contour map based on distribution and concentration of PAHs was constructed using a Surfer 7.0 software (Golden software, CO., USA) to characterize the spatial patterns of PAHs in road dust over Cairo.

2.4.4. Quality assurance

Two sample blanks were analyzed together with each batch of samples. Concentrations of PAHs in the blanks were below the detection limits in all analysis. Each standard and sample was measured in duplicate, and the sample was re-analyzed if the relative standard deviation of the two measurements was higher than 5%. Coefficients of variations of the three replicated of the samples were generally less than 10% and the mean was used as the representative value for the sample. In the present study, all laboratory tools used in sample collection, analysis, and storage were soaked in 10% HNO_3 for two days and then rinsed thoroughly with distilled and double distilled water, respectively, before use.

3. Results and discussion

PAH concentrations in road dust for all sites are presented in Table 2. Examined PAHs can be classified according to their number of aromatic ring as follows: 2-ring including NAP; 3-ring including ACE, FLU, PHE and ANC; 4-ring including FLA, PYR, BaA and CHR; 5-ring including BbF, BkF and BaP. The most abundant PAHs were 3-and 4-ring compounds with percentages of 61 and 35, respectively, consistent with Trapido [40] who reported the dominance of 3–4 ring PAHs in Estonian soil. In the current study, Σ 12 PAHs was seven-fold higher than the natural and background level of PAHs at remote or rural sites (0.1 mg/kg; [41]). It was demonstrated that PAHs in urban soils was 2–10 higher than rural ones [42,43].

Fluctuated concentrations of twelve PAH species were detected in road dust samples of all investigated sites. Total content of detected PAHs in road dust ranged between 0.045 and 2.61 mg/kg. The highest ones were recorded at Sites 4, 6, 12, and 11 with values of 2.61, 1.53, 1.40, and 1.28 mg/kg, respectively as illustrated in Fig. 2. Meanwhile, the lowest values were recorded at Site 2 (0.045 mg/kg), Site 3 (0.047 mg/kg), and Site 1 (0.054 mg/kg). Low levels at these sites could be attributed to low traffic densities/congestion, and absence of big industrial activities compared to other sites of higher PAHs levels.

The highest average concentrations for PAH species in Cairo's road dust were for PHE of 0.404 mg/kg followed by PYR and FLA with average levels of 0.166 and 0.068 mg/kg, respectively, consistent with those results found in Beijing [41]. Moreover, Bostrom et al. [2] found PHE to be the most abundant of 14 different PAHs compounds monitored at the street-level site in Stockholm. Meanwhile, the lowest measurable species in dust were BaP, ACE, BaA, and BbF with average concentrations of 0.0024, 0.0027, 0.0028, and 0.0035 mg/kg, respectively.

On individual scale, the highest concentrations were also for PYR (1.031 mg/kg) and FHE (1.028 mg/kg). The lowest concentration over all sites was for BaP species (0.0001 mg/kg). Furthermore, Table 2 shows that the highest concentrations of

Table 2
The total concentration of polycyclic aromatic hydrocarbons (mg/kg) in road dust of different sites over Greater Cairo

Site	PAHs species											
	NAP[a]	ACE	FLU	PHE	ANC	FLA	PYR	BaA[a]	CHR[a]	BbF[a]	BkF[a]	BaP[a]
1	0.0093	0.0082[b]	0.0006	0.0060	0.0086	0.0029	0.0091	0.0004	0.0065	0.0017	0.0003[c]	0.0003
2	0.0100	0.0082	0.0006[c]	0.0060	0.0150	0.0004[c]	0.0010	0.0004[c]	0.0008	0.0017	0.0004	0.0003
3	0.0075	0.0009	0.0006	0.0074	0.0150[b]	0.0004	0.0036	0.0035	0.0027	0.0017	0.0031	0.0009
4	0.0618[b]	0.0015	0.0413[b]	1.0284[b]	0.0150	0.3906[b]	1.0312[b]	0.0035	0.0027	0.0195	0.0050	0.0110
5	0.0178	0.0015	0.0413	0.8540	0.0016[c]	0.0060	0.0070	0.0005	0.0008	0.0195[b]	0.0070	0.0110[b]
6	0.0415	0.0005[c]	0.0413	0.8540	0.0086	0.1603	0.4178	0.0035	0.0023	0.0032	0.0003	0.0011
7	0.0428	0.0005	0.0149	0.1561	0.0016	0.0131	0.0682	0.0035	0.0008	0.0032	0.0003	0.0009
8	0.0087	0.0005	0.0169	0.0016[c]	0.0016	0.0178	0.0027	0.0036	0.0023	0.0007	0.0040	0.0009
9	0.0187	0.0007	0.0169	0.0074	0.0016	0.1565	0.0027	0.0036	0.0023	0.0006	0.0070	0.0009
10	0.0210	0.0008	0.0012	0.0074	0.0016	0.1565	0.0006[c]	0.0036	0.0023	0.0008	0.0070	0.0031
11	0.0040[c]	0.0070	0.0160	0.7380	0.0080	0.0178	0.4100	0.0036	0.0639[b]	0.0008	0.0070	0.0011
12	0.0384	0.0053	0.0169	0.7129	0.0080	0.1565	0.3927	0.0036	0.0639	0.0005	0.0040	0.0021
13	0.0052	0.0020	0.0058	0.8020	0.0086	0.0180	0.4060	0.0007	0.0006[c]	0.0032	0.0004	0.0011
14	0.0197	0.0020	0.0040	0.0705	0.0080	0.0126	0.0438	0.0065	0.0008	0.0006	0.0070	0.0021
15	0.0169	0.0020	0.0044	0.0072	0.0086	0.0140	0.0050	0.0065[b]	0.0009	0.0005	0.0080[b]	0.0031
16	0.0374	0.0020	0.0044	0.8020	0.0040	0.0180	0.0061	0.0007	0.0008	0.0004[c]	0.0040	0.0011
17	0.0040	0.0020	0.0044	0.8020	0.0020	0.0180	0.0072	0.0007	0.0010	0.0005	0.0030	0.0001[c]
Average	0.0215	0.0027	0.0136	0.4037	0.0069	0.0682	0.1656	0.0028	0.0091	0.0035	0.0040	0.0024

NAP, naphthalene; ACE, acenaphthene; FLU, fluorene; PHE, phenanthrene; ANC, anthracene; FLA, fluoranthene; PYR, pyrene; BaA, benzo(a)anthracene; CHR, chrysene; BbF, benzo(b)fluoranthene; BkF, benzo(k)fluoranthene; BaP, benzo(a)pyrene.
[a] Carcinogenic compounds.
[b] Maximum concentration carcinogenic contents.
[c] Minimum concentration carcinogenic contents.

PAH species were recorded at Sites 4 and 5 in similarity to the high atmospheric pollution in these areas due to industrial activities and heavy traffic [44]. In the same way, Smith et al. [18] demonstrated the contribution of air particulate matter to urban dust reflecting the direct vehicular emissions of PAH and showed a decrease trend in PAH concentrations in both of road dust and atmosphere due to dispersion and deposition.

PAHs levels in road dust of the current study were considerably lower than those collected in Birmingham, despite of higher atmospheric concentration of PAHs [45]. This is most likely to be due to Cairo climate enhancing the effects of photo-oxidation and volatilization, similar to the finding at Lahore, Pakistan [18]. On the other hand, PAH concentrations found in road dust in other studies were relatively lower than the current results. For example, 0.002 mg/kg in United Kingdom, 0.0069 mg/kg in Norway, 0.0011 mg/kg in Canada and 0.0033 mg/kg in Australia [27,46–48].

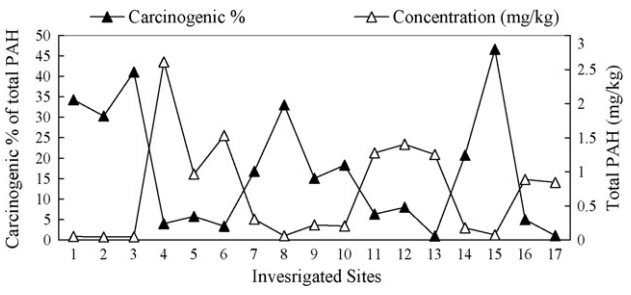

Fig. 2. Total concentrations of PAH and carcinogenic percent at investigated sites.

On the other hand, evaporation of PAHs to air from contaminated ground dust may be an important source with an average contribution 68% of total PAHs [26]. Also, PAH concentrations in soil were reported to be associated significantly with the corresponding levels in air [29,49,50]. Li et al. [26] suggested in their study that the typical subtropical climate in South China, cool and dry in winter, hot and humid in summer, may control the ambient concentration of PAHs in the air. Also, it has revealed the responsibility effects of temperature, rather than other metrological parameters on PAHs concentrations [9]. In this concern, prevailing climate of Egypt resembles that of South China, and a similar behave of PAHs in Egyptian environment is expected.

Regarding the obtained concentrations in the current study, levels of BaP were in the range of 0.001–0.0110 mg/kg. This range is quiet lower compared to typical concentrations of BaP in surface soils worldwide, which are reported between 0.1 and 1 mg/kg, and values as high as 650 mg/kg (10 m away from a German soot plant) have been reported [28]. Moreover, the current concentration of BaP is somewhat lower than 0.97, 0.53 and 0.15 mg/kg in Birmingham in UK, Germany and Japan, respectively [17]. The present results revealed significant variation in PAH road dust over all investigated sites as plotted in Fig. 3, reflecting the evidence that local traffic patterns played an important role.

An attempt to present the correlation analysis between detected PAH species is shown in Table 3. This table reflects that FLU and PYR were highly related to other species, while ANC has poor relation to other species. The strong correlation between PAH species provides evidence for similar emission source in all sampled areas.

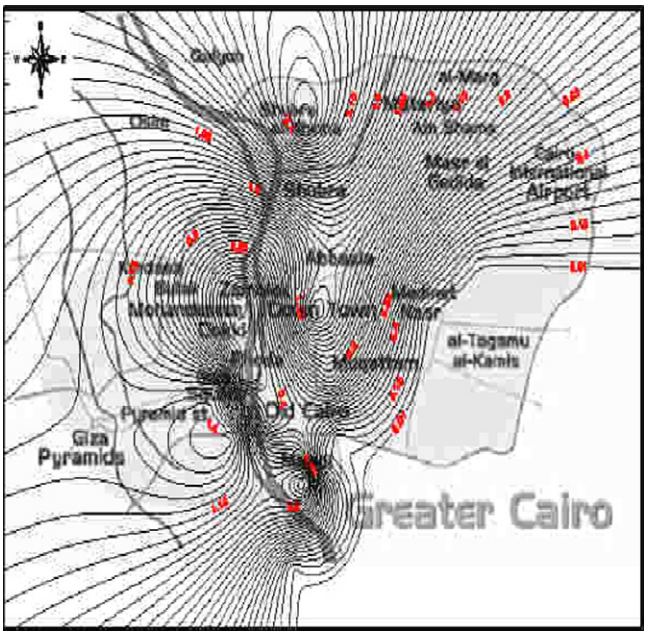

Fig. 3. Contour map of road dust PAHs distribution in Cairo.

The spatial variability in road dust PAHs concentration in Cairo was presented in Fig. 3. It involves 17 representative locations, with site-specific information gathered at each location as shown in Table 1. Distribution patterns of PAH in Cairo's road dust is obtained by processing data of species concentrations range between 0.045 and 2.6 mg/kg, as shown in Fig. 2, and visualized by a contour-map (Fig. 3). Spatial distribution of PAHs highlighted sites of high concentration, and as it has revealed from results, these hot-spot-sites are distributed throughout whole Cairo, i.e. Sites 4 and 5 in the north, Site 6 in the downtown, Site 11 in the west and Site 13 in the south. These sites are heavily traffic areas, in addition to the industrial activities at Sites 4 and 13. A moderate pollution was recorded also in Sites 5, 15 and 16.

Typical combustion origin PAHs can be indicated by Σ COMB (combustible PAHs species; FLA, PYR, BaA, CHR, BbF, BkF and BbP [51]. Higher ratios of Σ COMB to Σ PAHs represent more combustion activities [52]. Σ COMB/ΣPAHs ratios of street dust in the present stud were found to range from as low as 0.04–0.84. The highest ratios were for more traffic Sites 10, 9, 4, 8 and 15 with ratios of 0.84, 0.79, 0.56, 0.52 and 0.49, respectively. The mean ratio over Cairo accounted 0.36 indicating the influence of traffic emission on PAHs content.

The results of the present study indicated that the most abundant PAHs species were, PHE (57%), PYR (23%), FLA (10%) and NAP (3%). Similarly, PHE, PYR, and FLA species were reported to be the predominant PAHs in street dust samples collected from Tokyo metropolitan area [53], and Kuala Lumpur [54]. The high abundance of these species was supposed to be related to vehicle emissions [55,56]. Furthermore, it has demonstrated that enrichment of lower molecular weight PAHs in roadside dust particles could attributed to their predominance in larger atmospheric particles which deposit faster, in contrast to high molecular weight ones which predominate in smaller particles and deposit more slower from the atmosphere [9,57]. In consistent, the dominant PAHs in Southeast China soil were NAP, PHE and PYR, which were derived mainly from incomplete combustion [58]. Smaller loss of PAH in soil compared to the deposition from atmosphere [59], in addition to the continuous emission of PAHs were the main attributed factors. Moreover, Polkowska et al. [60] had found that PHE, FLA and PYR were the most often determined species among all PAHs of precipitation in Gdansk, Poland.

Pyrogenic and petrogenic sources are the most important input sources of PAH to the environment [61]. As a tool to distinguish between pyrogenic and petrogenic PAHs sources, the ratios of low to high molecular weight PAHs (LPAHs/HPAHs), PHE/ANC and FLA/PYR were commonly used [62–64]. While petrogenic PAHs are related to uncombusted petroleum products with higher 2–3 ring PAHs concentration [65], high molecular weigh PAHs are typical pyrogenic products derived mainly from fossil fuels combustion [66]. The mean proportion of LAPHs (NAP, ACE, FLU, PHE, and ANC) and HAPHs (FLA, PYR, BaA, CHR, BbF, BkF and BbF) in Cairo road dust accounts

Table 3
Correlation analysis of PAHs compounds in road dust of Cairo

	NAP	ACE	FLU	PHE	ANC	FLA	PYR	BaA	CHR	BbF	BkF	BaP
NAP	1.000	−0.301	0.571*	0.386	0.095	0.721**	0.577*	0.212	0.008	0.429	0.045	0.449
ACE		1.000	−0.301	0.059	0.409	−0.231	0.019	−0.339	0.506*	−0.179	−0.223	−0.229
FLU			1.000	0.597*	−0.040	0.567*	0.589*	0.032	0.071	0.743**	0.092	0.678**
PHE				1.000	0.037	0.359	0.653**	−0.341	0.274	−0.503*	−0.069	0.430
ANC					1.000	0.208	0.464	0.062	0.096	0.139	−0.253	0.081
FLA						1.000	0.757**	0.214	0.082	0.457	0.161	0.510*
PYR							1.000	0.094	0.320	0.505*	−0.065	0.464
BaA								1.000	0.135	−0.198	0.534*	0.018
CHR									1.000	−0.175	0.185	−0.097
BbF										1.000	0.141	0.940**
BkF											1.000	0.418
BaP												1.000

* Significant correlation at: $p < 0.05$.
** $p < 0.01$.

64 and 36%, respectively. The predominance of LPAHs was reported also by Yu et al. [58] who attributed this finding to a more recent contamination and the replacement of contamination. Due to similar physicochemical properties of PHE and ANC, as well as FLA and PYR, variability of PHE/ANC and FLA/PYR ratios can reflect source characters [67]. Usually, PHE/ANC ratio greater than 10 and FLA/PYR ratio less than 1 indicate the pyrogenic origin of PAHs, and PHE/ANC greater than 10 and FLA/PYR greater than 1 are characteristic of petrogenic origin [67]. In our study, average value of PHE/ANC was greater than10 and the corresponding value of FLA/PYR was less than 1. The obtained results in the current study indicated that PAHs in street dust have both petrogenic and pyrogenic origin sources.

Concerning the carcinogenic species, according to IRAC [4,5] and EPA [68], results of Fig. 2 showed that the highest percentages of six carcinogenic PAHs, NAP, BaA, CHR, BbF, BkF, and BaP, were found to be at Sites 15 (46.6%), 3 (41.1%), 1 (34.3%), 8 (33.0%) and 2 (30.3%). BaP has been reported as the main indicator of carcinogenic PAHs [2]. The current results indicated that carcinogenic species were detected as a maximum concentration value at four investigated sites, i.e. NAP at Site 4, BbF and BaP at Site 5, CHR at Site 11, and BaA and BkF at Site 15. The lowest carcinogenic percentages were found at Sites 13, 6, and 17 with percent values of 0.2, 0.4 and 0.5%, respectively.

Our data indicate that resident living in these areas are at a potential risk of exposure to the toxic effects of the various types of PAHs, in agreement with other studies [69], which demonstrated a potential risk for exposure to high levels of PAHs for road users and those living in urban environments.

4. Conclusions

As far as we know, this is the first comprehensive information on PAH spatial distribution pattern in different district areas of Greater Cairo, Egypt. This work revealed the road dust contamination with PAHs residues in different district areas of Cairo. It extends our understanding of the current PAHs contamination status in this mega city. The average concentration of 12 PAHs was 0.704 mg/kg with carcinogenic content of 17.1% of total PAHs. The present study confirms the contribution of vehicular traffic, industrial emissions and the incomplete combustion of open waste burning to road dust PAHs. Plotting PAH results on a map of city can be used to advantage in investigating road dust pollution and its potential deleterious effects. This study suggested that the pollution of PAHs in Cairo should emphasize on controlling the industrial emissions and traffic exhausts.

Further work is required to develop this preliminary investigation, including many more measurements in locations representing other activities. It is also realized that typical environment in Egypt of high temperature and relative humidity, coupled with abundant sunshine, may differ the chemistry of PAHs from that of other geographical regions.

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