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SURVEY ON AIR POLLUTANTS AROUND SOME INDUSTRIAL FACTORIES IN "EL-KAHLRA EL-KOBRA" AND ITS TOXICITY ON ALBINO RAT

Nabila ,M. Abdel-Alim* ; EL-Shawarby , R .M.*

By

* Dept. of Forensic Med . & Toxicology
Fac. of Vet. Med. Zagazig University , Benha Branch.

SUMMARY

This work determined the levels of certain pollutants(SO_2, NO, CO_2, CO, Benzene, Toluene) in air surrounding some factories in EGYPT especially in "Greater Cairo". Levels of air pollutants were determined using Infrared Spectroscopy. The results obtained were compared to the permissible levels recorded in the law on the Egyptian Environment (Law 4 for 1994) .The obtained results revealed that some pollutants as sulfur dioxide, nitrous oxide and benzene levels in the ambient air around some factories exceeded the permissible limit recorded in the Egyptian law.The toxicity of pollutants So_2, No and Benzene were studied on the blood gases values "PO_2 and Pco_2 " and acid base status of rats exposed to highest recorded levels of that pollutants .

INTRODUCTION

Advances in technology, throughout the world have caused increase in the number and amount of chemicals in the atmosphere (Neil., et al 1978). Factories as oil refineries, steel mills, smelters, synthetic materials were built with too little concern about the effect of their waste products in the environment . Motor cars constitute a major source of pollution to the atmosphere. Although sulfur dioxide would be the major pollutant of smelter, carbon monoxide, hydrocarbons and nitrogen oxide are the major pollutants of motor cars (Amdur,1982).

Brief et al (1980) recorded that benzene is one of the volatile organic compounds used in industry for preparation of benzene ring derivatives, including polymers, detergent, pesticides, chlorinated solvents, adhesives, printing inks and degreasing and cleaning agents.

Fishben (1985) mentioned that toluene is present in gasoline and also in benzoic acid, pharmaceuticals, food additives, plastics and in many consumer products including household

aerosols, paints, varnishes, rust preservatives, adhesives, glue and sanitizing agents. The WHO. (1997) recorded that nitrogen oxide became the principal pollutant in the environment of large cities of certain countries such as China and Egypt; and that carbon monoxide is emitted to the atmosphere mostly due to the incomplete combustion of fuel and other organic materials.High levels of carbon monoxide are found in homes with gas appliances, in underground and multistory car parks, road tunnels, enclosed ice arenas and other indoor environments, in which combustion engines are used under conditions of poor ventilation.

Neil et al (1978) recorded that nitrogen dioxide caused bronchiolar epithelial hyperplasia, odema, epithelial metaplasia, fibrosis and necrosis in the lungs. Johnston et al.(1979) found that pigs exposed to different doses of benzene vapor 6 h/d.,5d./wk.,for three weeks showed depression of white cell counts and total lymphocyte. Menzel and Meclellan (1980) recorded that nitrogen oxids affected the terminal respiratory bronchi and alveoli and caused pulmonary congestion, edema and emphysema, while sulfur dioxide affected the upper air passages and caused bronchoconstriction, cough, tightness in the chest. Cobb (1981) mentioned that sulfur dioxide and toluene vapors may cause irritation of trachea and bronchi, while Gradiski et al (1981) recorded that chronic inhalation of 50 ppm benzene caused leucopenia.Dockery et al (1982) reported that a decrease in pulmonary functions occurred in 335 childrens located in a polluted area (having 312 $\mu g/m^3$ total solid particle and 455 µg/ m3 So2). Gaido and Wierda (1989) stated that benzene or its metabolites are cytotoxic for hematopoietic and stromal cells.Pope et al (1991) recorded that high levels of certain air pollutants as sulfur dioxide and nitrous oxide were associated with a reduction in lung functions and an increase in symptoms of respiratory diseases and asthma medication use.

David et al (1992) reported that benzene was associated with leukemia, aplastic anemia, myloma, lymphoma and lung cancer. Skyberg et al (1992) recorded that PO_2 and Hbo_2 were reduced in workers employed for at least three years in oil impregnation of cables.

The present work aimed to give some information (assmment risk) about the levels of certain air pollutants emitted from some factories in "Elkahra Elkobra" and in some crowded squares. Moreover, to study the toxic effects of some pollutants "sulfur dioxide, nitrous oxide and benzene" on blood gas parameters of albino rats.

MATERIAL AND METHODS

Materials

A: Apparatus

1-MIRAN IB Portable Ambient Air Analyzer (Foxboro USA), which is a single beam infrared spectrophotometer. It is used for the measurement of organic vapors,hazardous gases and toxic gases in addition to inorganic gases. Gas concentrations measured were represented in term of " part per million" ppm.

2- Blood Gas Analyzer "ABL 510 RADIOMETER".

B:Experimental animals

Twenty four male Albino rats weighing from 100-120 grams were used in this study. The animals were divided into four groups each has six rats. Each group was kept in a closed chamber "static inhalation chamber".The first, second and third groups were exposed to 118, 28, and 51mg/m^3 of sulfur dioxide, nitrous oxide and benzene 8h /d for 7 days respectively. A fourth group was kept in a similar closed chamber for the same time and used as control.

Methods.

A: Environmentaly samples:

Air samples from different distances around and away from a number of industrial plants and in ambient air in different squares in Cairo (EL-KAHRA EL- KOBRA)were analyzed (table 1) by using Infrared Spectrophotometer (MIRAN IB) .Gases of sulfur dioxide, carbon monoxide, carbon dioxide, nitrous oxide, and some other volatile organic compounds as benzene and toluene, were monitored.

B: Animal samples:

Heparinized blood samples (arterial blood from left ventriele) were taken from lightly ether anaesthetized animal. Blood gases were determined by using the blood gas analyzer.

C: Calculation:

A-Convertion of ppm to mg/m^3:

Conversion of data from ppm to mg/m^3 was carried out in order for the data to be easily compared to the permissible limits present in the Egyptian Environmental Law.

Conversion of the measured gases from ppm to mg/m^3 was done according to the following equation:

Reading by mg/m^3 = reading by ppm X gas density; with density of gases at 0°C being (9/L) as follows:2.8385 "SO2", 2.1833 "NO", 1.9769 "CO2", 1.2504 "CO", 3.2748 "benzene" and 4.1071 "toluene"(Hodgman, 1947) . For recording gas density at 25°C, the following equation was used:

Density of gases at 25°C = Density of gas at 0°C ÷ (cofficient of gas X 25)+ 1.

The cofficient expansion of gas is the proportion of volume increase of gas by rising the temperature 1°C =0.003665 (Hodgman, 1947) .

Preparation of gases for the laboratory experiment: Gases under investigation were prepared to give the desired amount according to Baker and Knapp (1978) .

For sulfur dioxide :

Na2So3 + 2 HCL --------- 2NaCL + H2O + SO2.

For nitrous oxide:

CU + 8 HNO3 ---------- 3CU (NO3) 2 + 4. H2O +2 NO

E:Statistical evaluation : The results were have been statistically evaluated by the "t" test, using statease program (1986).

Table (1): Gases monitored from different distance away from some factories or within site in some locations.

* Location 1to7 represent firms and companies; locations 8 and 9 represent squares in Cairo city.

RESULTS

Sulfur dioxide levels:

Table (2) shows levels of sulfur dioxide exceeded the permissible limits"in ambient air"recorded in the Egyptian Environmental Law in all locations under investigation. Comparison of sulfur dioxide levels to the permissible limit that should not be exceeded inside the factories (table 8.2) show excess in limits (for average time exposure) except for Abou Zaabal Company for Chemicals & Fertilizers in which SO_2 was 3.5mg/m^3 in comparison to5mg/m^3 in Egyption Law. Sulfur dioxide exceeded permissible limit "for short time exposure " in El-plastic Elahlia as well as in the Masbic Nhas Eltoncy company.

Nitrous oxide levels.

Table (3) shows that nitrous oxide levels in all companies under study were higher than the permissible limit in ambient air. Nitrous oxide level at El-plastic Elahlia company was 28 mg/m^3 which is far greater in Comparison with 6 and 10 mg/m^3 permissible limite cited in the Egyptian Environmental Law for average and short time exposure respectively. Nitrous oxide levels at Shobra square was 7.6 mg/m^3 in comparison with the 6mg/m^3 " permissible limit cited in the Egyptian Environmental law" for average time exposure.

Benzene levels:

Table (4) shows the levels of benzene in Shobra and Ramses squares; which were being 45 and 51 mg/m^3 respectively in comparison to 30 mg /m^3 which are higher than the limit cited in the Egyptian Law foraverage time exposure.

Carbon dioxide,carbon monoxide and toluene levels:

Tables (5, 6, 7) showed that carbon dioxide, carbon monoxide and toluene levels in the air away from different company were within the permissible levels of that recorded in Egyptian Environmental Law.

Blood gases values:

Table (9) & Fig.(1) illustrated the effect of sulfur dioxide , nitrous oxide and benzene on partial pressure of oxygen and carbon dioxide in blood of Albino rats. Highly significant decrease in partial pressure of oxygen occurred in the first, second and third groups, values were 29.8 ± 3.8, 33.3 ± 7.1 and 34.3 ± 3.6 mmHg respectively against 71.33 ± 1.8 mmHg in the control group which was not subjected to gases. Highly significant decreases in partial pressure of carbon dioxide also occurred in the 1st, 2nd and 3rd groups exposed to So_2 or NO or benzene respectively. Values of partial pressure of carbon dioxide were 41.57 ± 1.1, 40.7 ± 1.2 and 39.27 ± 0.6 mmHg for the first, second and third groups respectively in comparison with 46.7 ± 0.27 mmHg for the control group.

Acid base status:

Results concerning acid base status of Albino rats are shown in Table (10) and Fig. (2). Significant decrease in pH values in blood occurred in the

Table: 1 Gases monitored from different distance away from some factories or within site insome locations.

Location (site)*	Distance (m2)	Gases measured
1-Egyptian Aluminum sulfide Company.	500	So2, Co, co2, No
2-Abou Zaabal Company for Fertilizer andChemicals.	100	So2, Co, Co2, No.
3- Petroleum Pump Company.	100	So2, Co, Co2, No, Toluene.
4- Mobil Petrolium Company.	100	So2, Co, CO2, No, toluene .
5-El-plastic El-ahlia Company.	100	So2, Co2, No
6-Masbic Nhas EL- Toncy.	100	So2
7- Egyptian Company for lead tubes .	Inside	So2, Co, Co2, Benzene, Toluene.
8-Shubra square .	Inside	Benzene.

Table(2): Sulfur dioxide level in air around different industerial companies in Egypt in comparison with the permissible limit in Egyptian Environmental law (Law 4 for 1994).

Locality	Distance (m2)	So2 levels		So2 in ambient air			So2 in factories	
		ppm	mg/m3	So2/h	So2 /24h	So2/ year	Average time	Short time
Egyptian Aluminum Sulfied Company .	500	3.4	8.5	+	+	+	+	-
Abou Zaabal Company of Chemical and Fertilizer .	100	1.4	3.5	+	+	+	-	-
Petrolium Pump Company .	100	2.5	6.25	+	+	+	+	-
Mobil Petrolium Company.	100	2.3	5.75	+	+	+	+	-
El-plastic Elahlia Company .	100	47.2	118	+	+	+	+	+
Masbic Nhas El Toncy.	100	10.4	26	+	+	+	+	+
EgyptianCompany for lead tube .	100	7.3	18.3	+	+	+	+	-

+ Exceed permissible limit.
- Withen permissible limit

Table(3): Nitrous oxide level in air around different industreial companies in Egypt in comparison with permissible limit in Egyptian Environmental law (Law 4 for 1994).

Localit	Distance (m2)	No		No in ambient			No in factories	
		ppm	mg/m3	No/h	No/24	No /year	Average time	Short time
Egyptian Aluminum sulfied company.	500	2.6	5.2	+	+	+	-	-
Abou Zaabal Company of Chemical and Fertilizer.	100	1.2	2.4	+	+	+	-	-
Petrolium Pump Company.	100	1.3	2.6	+	+	+	-	-
Mobil Petrolium Company.	100	1.4	2.8	+	+	+	-	-
Elplastic Elahlia Company.	100	1.4	28	+	+	+	+	+
Shobra square.	Inside	3.8	7.6	+	+	+	+	-

+ Exceed permissible limit.
- Withen permissible limit

Table (4):Benzene level in the air in certain crowded squares in Egypt in comparisson with permisible limit in Egyptian Environmental Law (Law 4 for

Locality	Distance (m2)	Benzene		Benzene	
		ppm	mg/m	Average time	Short time
Shobra square	Inside	15	45	+	-
Rames square	Inside	17	51	+	-

+ Exceed permissible limit.
- Withen permissible limit

Table(5): Carbon dioxide level in air around different industreial compan in Egypt in comparison with the permissible limit in Egyptian Environmental law (Law 4 for 1994).

Locality	Distance (m2)	Carbon dioxide		No in factories	
		ppm	mg/m3	Average time	Short time
Egyptian Aluminum sulfied company .	500	139	250.2	-	-
Abou Zaabal Company of Chemical and Fertilizer .	100	97	174.6	-	-
Petrolium Pump Company .	100	71	127.8	-	-
Mobil Petrolium Company.	100	85	153	-	-
Elplastic Elahlia Company .	100	44	88	-	-
Masbic Nhas El toncy.	Inside	88	158	-	-
			151.2	-	-

+ Exceed permissible limit.

- Withen permissible limit

Table (6):Carbon monoxide level in air around different industreidal companies in Egypt in comparisson with permisible limit in Egyptian Environmental law (Law 4 for 1994).

Locality	Distance (m2)	Co levels		Co in ambient air		Co in factories	
		ppm	mg/m3	Co/h	Co/24th	Average time	Short time
Egyptian Aluminum sulfied company.	500	1.1	1.21	-	-	-	-
Abou Zabal Company of Chemical and Fertilizer.	100	1	1.1	-	-	-	-
Petrolium Pump Company.	100	4.8	5.28	-	-	-	-
Mobil Petrolium Company.	100	3.4	3.7	-	-	-	-
Shobra square.	Inside	1.5	1.65	-	-	-	-

+ Exceed permissible limit.

- Withen permissible limit.

Table (7):Toluene level in air around different inustreial companies in Egypt in comparisson with permisible limit in Egyptian Environmental law (Law 4 for 1994).

Locality	Distance (m2)	Toluene		Benezene	
		ppm	mg/m3	Average time	Short time
Petrolium Pump Company.	100	32	12	-	-
Mobil Petrolium Company.	100	3.4	12.75	-	-
Shobra square.	Inaisde	5.3	19.88	-	-
Ramses square.	Inaisde	8.9	22.28	-	-

+ Exceed permissible limit.
- Withen permissible limit.

Table (8.1):Recommended guidelines values of the examined air quilty constituents as recorded in the Egyptian environmental law (Law 4 1994). 1994).

Air quility constituent	Maximum permisseble limite for certain pollutants in ambient air (mg/m^3)		
Sulfuer dioxide	0.35/h	0.15/24 h	0.06/year
Carbon monoxide	30/h	10/8 h	-
Nitrous oxide	0.4/h	0.15/24 h	-

Table (8.2):Maximum permissble limit for certain air pollutants according to the type of each industry.

Air quility constituent	Average time		Short time	
	mg/m3	ppm	mg/m3	ppm
Sulfuer dioxide	5	2	10	5
Nitrous oxide	3	3	10	5
Benzene	30	10	75	25
Carbon dioxide	9000	5000	27000	15000
Carbon monoxide	55	50	4400	400
Toluene	375	100	560	150

N.B. Average time: Average time for normal working day (8h) in which worker can exposed to pollutant for 5 days / week without harmfull effect in health.

short time exposuer: Workers not exposed more than 15 min. four time / day (time betwen two exposuer 60 min. at least).

Table (9): Blood gases value (Po2, PCo2) of Albino rats exposed to sulfur dioxide, Nitrous oxide and Benzene for one week (Mean ± S. E.).

Group	PO2 (mmHg)	PCO2 (mmHg)
First group (exposed to 118 mg/m3 So2).	29.8 ± 3.8**	41.57 ± 1.1**
Second group (exposed to 28 mg/m3 No).	33.3 ± 7.1**	40.7 ± 1.2**
Third group (exposed to 51 mg/m3 benzene.	34.3 ± 3.6**	39.27 ± 0.6**
Fourth group (control group).	71.33 ± 1.8	46.7 ± 0.27

* Significant at $P < 0.05$.

** Significant at $P < 0.01$.

Table (10): Acide base status (pH, Hco3 & Tco2) of Abino rats exposed to sulfur dioxide, Nitrous oxide and Benzene for one week (Mean ± S. E.).

Group	PH	Hco3 (mmol/l)	Tco2 %
First group (exposed to 118 mg/m3 So2).	6.9 ± 0.0**	14.6 ± 1.5**	37.9 ± 1.09
Second group (exposed to 28 mg/m3 No).	6.98 ± 02**	15.8 ± 0.9	40.4 ± 2.1
Third group (exposed to 51 mg/m3 benezen.	6.8 ± 0.1**	15.5 ± 0.64	42.7 ± 1.4
Fourth group (control group).	7.54 ± 04	35.7 ± 1.5	40.95 ± 2.5

* Significant at $P < 0.05$.

** Significant at $P < 0.01$.

first, second and third groups; values were 6.9±00.0, 6.98±0.02 and 6.8 ± 0.01 respectively in comparison with 7.54 ± 0.04 in the control group. Bicarbonate levels decreased in rats exposed to gases under the current study. Bicarbonate levels were 14.6 ± 1.5, 15.8 ± 0.9 and 15.5 ± 0.64 mmol in the first , second and third groups respectively in comparison with 35.73 ± 1.5 mmol/L in the control group. There was no significant effect of the pollutants on total Co_2 of the blood.

DISCUSSION

Egyptian Environmental Law (Law 4 for 1994) help to protect public health, eliminate or reduce to a minimum concentrations of air pollutants both indoors and outdoors, to make risk management decisions.It also helps to guide government in developing national and regional plans. Levels of some pollutants in the air around some factories and withen certain square in Cairo" Elkahra Elkobra " were measured. Our study revealed that sulfur dioxide, nitrous oxide and benzene levels exceeded the permissible limit recorded in the Egyptian Environmental law.These results are in agreement with those mentioned by the WHO.(1997) which states that nitrogen oxides is the principal pollutant in large cities as Egypt. Exposure to benzene vapor was reported to cause depression of white cell counts and total lymphocyte, leukemia, aplastic anemia and lung cancer Johnston et al.(1979) and David,et al (1992). Also Dazevedo, et al., (1996) recorded that benzene produces hematologic changes ranged from pancytopenia to total bone marrow aplasia. High levels of sulfur dioxide, nitrous oxide were reported to cause irritation of trachea and bronchi, bronchial epithelial hyperplasia, edema, fibrosis and necrosis in the lungs, reduction in lung function, asthma, increase or decrease in respiratory frequency (Neil, et al., 1978; Menzel and Meclellan 1980, Dockery et al., 1982 and Pope et al., 1991). Nitrous oxide has been reported to be teratogenic in rats (Hansen and Billings, 1985).

In the current study a highly significant decrease in partial pressure of oxygen occurred in all treated groups. Such results are in agreement with those of Skyberg et al., (1992) who recorded reduction of Po2 in workers employed in oil impregnation of cables. Such effects may be attributed to pollutants affecting the rate of oxygen transport from lungs, Benzene was reported to cause edema, epithelial metaplasia, fibrosis and necrosis (Neil et al., 1978). Sulfur dioxide and nitrous oxide were reported to cause bronchoconstraction, pulmonary congestion , edema (Menzel and Meclellan, 1980) as well as reduction in lung function, asthma (Pope et al., 1991). Such effect may be attributed to its presence in air leading to effect in the 2nd part of tracheal epithelium. Also highly significant decrease in partial pressure of carbon dioxide in all treated groups. Diminution of partial pressure of carbon dioxide in blood would confirm the diminution of oxygen transport; which leading to suppressive effect on oxidative processes.

Highly significant decrease in pH and bicarbonate levels in blood of all treated groups exposed to air pollutant rendering them more acidic. Moreover total Co2 level in blood showed

no remarkable change.

Conclusion:

Efforts have been made on a national as well as on international levels to arrive at air quality standards as a rational basis to control levels of pollutants in environment .So it is important to monitoring of many disciplines in Egypt and interpret the results of researches in many disciplines.

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