AIR POLLUTION LEVELS IN PARTS OF KANO METROPOLIS, KANO STATE NIGERIA

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ABSTRACT: The gaseous pollutant in selected areas of Kano metropolis were determined, using Crowcon-gasman gas level meter. The types of the gaseous elements detected are carbon monoxide (CO), Hydrogen sulfide (H_2S), Methane (CH_4), Ammonia (NH_3), Nitrogen dioxide (NO_2) and sulphur dioxide (SO_2). The concentration of each in the air was measured and compared with the Standard limit approved by the World Health Organization and Federal Ministry of Envronment. The Maximum mean concentration of each gas and the locations are as follows:- 7.69 ± 0.01ppm for CO at Sani Abacha way (North West of the Kano metropolis), 1.66 ± 0.01 ppm for H_2S at Bank road roundabout (North of the Kano metropolis), 2.00 ± 0.01ppm each for CH_4 at Dangi roundabout (South-West of the metropolis), Gyadi-gyadi roundabout (North of the Aminu Kano teaching hospital) and Bata area (central area the metropolis) , 2.00 ± 0.01 ppm for NH_3 at Gidan Murtala roundabout (East of the Emirs palace Kano), 0.10 ± 0.01 ppm for NO_2 at Murtala Mohammed road kasuwan rimi (South of Maska LEA Primary School Kano metropolis), and 0.10 ± 0.01ppm for SO_2 Murtala Mohammed road kasuwan rimi and ring road (South East of the Kano metropolis) sites. The result revealed that Murtala Mohammed road has an exceeded level of SO_2 when compared with the WHO maximum allowable limit of 0.5ppm indicating that people living in the area are liable to suffer some health problems. The result further revealed that there is more emission of gases in industralized and densely populated areas e.g. Gidan Murtala roundabout than less densely populated areas such as G.R.A. It also shows that the concentrations are generally higher in the afternoons for the busy and industrialized areas while for some roads it was in the evenings.

INTRODUCTION

Environmental pollution is the altering of any component of the environment by introduction of foreign substances called pollutants. This pollutant may or may not be harmful, but are capable of changing the physical, chemical and/or biological component of the environment. These include dust, smoke, smog, fungi, radiation, pressure, heat, wax and phosphates (WHO, 2004). Air pollution is the presence in the atmosphere of one or, more chemicals e.g. CO_2, NH_3, NO_2, particulate matter and dust etc., in high concentration to harm humans, animals or vegetation. It is a major problem in urban cities of the world due to industrialization and rapid urbanization thereby posing threat to human health (Adeyomey, 2002).

In Nigeria, research shows that people leaving in areas full of fog, polluted and populated environments (e.g those living near industries) suffer pollution related Health problems (Akinsola 1993). Long term health effect can include chronic respiratory disease, cancer, health diseases, and damage to brain, nerves; liver, kidney. Continual exposure to air pollution affects the lungs of growing children and might aggravate or complicate medical conditions (Ladigbolu *et al*. 2010; Agrawark, 1999 and Ball, 1984).

This work investigated the presence and level of the gaseous pollutant within the Kano metropolis.

Sources of air Pollution and effects

Five major sources were identified as sources of air pollution in our environment (Federal Ministry of Environment, 1991; WHO, 2004 and Miller, 2006). These includes:-

(i) Industrial Sources: air pollution arising from industrial activities such as sorting, processing, mixing, burning etc.. The formation of CO_2 is the major consequence of burning fossil fuels., since CO_2 is relatively chemically inert; its production does not lead to important consequences for human health. Incomplete combustion of carbonated material can however, lead to the formation of carbon monoxide. Carbon monoxide is an odorless colorless gas that is toxic since it combines with the hemoglobin in the red blood cells more rapidly than oxygen. Hence, CO tends to block the distribution of oxygen around the body and can lead to suffocation and death. Concentration of 100 parts per million (ppm) in air for ten hours will lead to headaches and reduced ability to think clearly, while 300ppm will result in nausea and possible loss of consciousness, and 100ppm for dust an hour can result in death within 4 hours. The most dangerous to human health may be in the form of particulates matter. The particulates enter the human body through nose where the larger particulates might be removed by nasal hair or trapped in the mucous membrane of the airways. However the smaller particles can reach the lungs and reduces the efficiency of the lungs, or through the release of chemical stored within the particulate causing bronchitis and emphysema.

(ii) Commercial Source: Commercial activities can pollute the air. The common air pollutants emanating from commercial process include smoke, gaseous particulates, dust, fumes and air pollutant that can be from land water origin (WHO, 2004).

(iii) Institutional Source: Institutional like school i.e. (educational) hospitals, orphanage, administrative offices in the form of ministries and parastatals are known to generate air pollutants, but its intensity depends on activities perform by such institution.

(iv) Municipal Source: Air pollution of municipal origins commonly from domestic premises is one of the sources of pollution. Common pollutant from this source includes carbon dioxide, carbon monoxide, which is produced due to decomposition of organic matters, burning, cooling, and other domestic activities.

(v) Agricultural Source: Includes all pollutants resulting from agricultural activities ranging from pre-planting operation, plough and harrowing to planting and post planting operations, which all includes seedling weeding application of fertilizer, herbicides, fungicides, pesticides etc., all of which result in emitting smoke smog, mist, dust, particulate maters, carbon oxide, sulfur oxide, cyanide compound, nitrogen oxide and ammonia etc. (WHO, 2004)

Types of Air Pollutants

Sulfur Dioxide (SO_2)

Sulfur dioxide is a pollutant associated with acid deposition. It reacts with OH to form HSO_3 which forms sulphuric acid (H_2SO_4) Sulphuric acid is generally present as an aerosol associated with other pollutants. SO_2 in the atmosphere arises from both natural and human activities. Natural processes which release sulphur compounds include decomposition and combustion of organic matters, spray from the sea and volcanic eruption. The main human activities producing SO_2 are the smelting of mineral ores containing Sulphur, combination of Sulphur components which are as natural constituent of fossil fuels, particularly led and soil. As a consequence the source of SO_2 includes domestic fluke combustion, industrial process and power stations. Small quantities are also emitted from diesel engine vehicles (Bange *et al.*, 1996).

High concentrations of SO_2 can give rise to health respiratory effects which can aggravate bronchitis. Other environmental effects of this gas include it toxicity to plants, corrosion to buildings, both stone work metals. It also affects paper, fabric, leather and the upper respiratory tract and lung tissues in combination with moisture and oxygen, they may form acid rain (Bange *et al*, 1996).

Oxides of Nitrogen (NO_2)
The oxides of nitrogen present in the atmosphere are nitric oxide (NO), nitrogen dioxide (NO_2) and nitrous oxide (N_2O). The last occurs in much smaller quantities than the first two. Most anthropogenically emitted NO_2 is derived from NO Once NO is emitted into the atmosphere; majority of it is rapidly oxidized to NO_2 through reaction with O_3, or other oxidant. It is a reddish brown gas, a strong oxidant and soluble in water (Agrawark, 1999). The major human activity which generates oxides of nitrogen is fuel combustion, in motor vehicles the emission of NO_x during combustion is temperature dependent with more NO_x emitted with higher temperature combustion process (EPA, 1993). The principal natural sources are biomass burning, lightening, microbial activity, biological processes, ammonia oxidation and stratospheric input (EPA, 1993).

Carbon monoxide (CO)
CO is produced by incomplete combustion of fossil fuels and wildfire. It is also produced, naturally by oxidation of methane produced from organic decomposition in cities, the motor vehicle is the largest artificial source. It is absorbed through the lungs and reacts with haemoproteins, especially with hemoglobin of the blood; this in turn results in a reduction of the oxygen carrying capacity of the blood and also interferes with the release of the oxygen which is carried to the tissues.

Methane (CH_4)
Methane is the most abundant reactive trace gas in the atmosphere and arises from both natural and anthropogenic sources. While carbon dioxide receives the most attention as a factor in global warming, there are other gases to consider, including methane, nitrous oxide (N_2O) and chlorofluorocarbons (CFCs).

Hydrogen Sulfide (H_2S)
Hydrogen sulfide is produced naturally and as a result of human activities. Natural sources account for about 90% of the total H_2S in the atmosphere (EPA, 1993). It is produced naturally through anaerobic bacterial reduction of sulfates and sulfur-containing organic compounds (Hill, 1973). It is found naturally in crude petroleum, natural gas, volcanic gases, and hot springs. H_2S is also found in groundwater, it is emitted from stagnant or polluted waters and manure or coal pits with low oxygen content. Hydrogen sulfide is emitted by some plant species as a by-product of sulfite metabolism (Wilson *et al*., 1978). Hydrogen sulfide may be produced by a variety of commercial methods, including reacting dilute sulfuric acid with iron sulfite, heating hydrogen and sulfur into their vapor phase, and heating sulfur with paraffin.

Hydrogen sulfide is also produced as a decomposition product of xanthine (used in the mining industry). Improper disposal of materials resulting from these processes may result in hydrogen sulfide emissions. WHO (2004) reported that exposure of 42 individuals to 2.5 to 5 ppm (3.5 to7 mg/m^3) H_2S causes coughing and throat irritation after 15 min.

Ammonia (NH_3)
Ammonia is a naturally occurring substance that is contained in all life forms, from plants to animals to humans. Life forms could not have evolved and cannot survive without it. Ammonia is used extensively in the production of a wide range of food and beverages. Air in urban areas contains up to 20 µg of ammonia per m^3. Air in areas where farm animals are intensively reared may contain levels as high as 300µg/m^3 (EPA, 1989).

Taste and odor problems as well as decreased disinfection efficiency are to be expected if drinking-water containing more than 0.2 mg of ammonia per litre is chlorinated, as up to 68% of the chlorine may react with the ammonia and become unavailable for disinfection. Cement mortar used for coating the insides of water pipes may release considerable amounts of ammonia into drinking-water and compromise disinfection with chlorine. The presence of elevated ammonia levels in raw water may interfere with the operation of manganese-removal filters because too much oxygen is consumed by nitrification, resulting in moody, earthy-tasting water. The presence of the ammonium cation in raw water may result in drinking-water containing nitrite as the result of catalytic action or the accidental colonization of filters by ammonium-oxidizing bacteria (WHO, 2004).

Ammonia has a toxic effect on healthy humans if the intake becomes higher than the capacity to detoxify. With ammonium chloride, the acidotic effects of the chloride ion seem to be of greater importance than those of the ammonium ion. At a dose of more than100 mg/kg of body weight per day (33.7 mg of ammonium ion per kg of body weight per day), ammonium chloride influences metabolism by shifting the acid–base equilibrium, disturbing the glucose tolerance, and reducing the tissue sensitivity to insulin (EPA, 1989).

MATERIALS AND METHOD

Study area

Kano is the capital city of Kano state, Nigeria, in the Sahelian geographic region south of Sahara. Its metropolitan population of 2,828,861 is the second largest in the country after Lagos as at 2006 census. It is located at 12^{o}N, 8.51^{o}E within a time zone of UTC+1. The metropolis covers an area of 499 km^2. The activities of the people include business, farming and hunting. The city is known for its industries and commercial activities throughout Africa.

Sampling

The sampling technique used was random sampling. During the field measurement, Crowcon Gas-Man detectors of various types of gases used to detect and measure the amount and level of gaseous waste generated from different areas. The study area was demarcated and labeled as follows: (A) Gidan Murtala roundabout (East of the Emir’s palace Kano metropolis), (B) Murtala Muhammed/KasuwanRimi (South of Maska LEA primary school central area), (C) Nasarawa/Matan Fada Road (South West of the metropolitan police station), (D) Sani Abacha way (North West of the Kano metropolis), (E) Zungeru/Airport road (North of Kano club Gulf course), (F) G.R.A. I (East of the metropolis), (G) Ring Road (South East of the metropolis), (H) Ahmadu Bello/Hadejia Road (East of the Kano club Gulf course), (I) Sokoto Road (South East of the Emir’s palace), (J) State Road (South East of the Kano fire brigade Head quarters West of the metropolis), (K) Dangi Roundabout (South West of the Kano metropolis), (L) Justice Dahiru Mustapha Road (Central area), (M) Gyadi-gyadi Roundabout (North of Aminu Kano teaching hospital), (N) Maiduguri Roundabout Tarauni (South East of the metropolis), (O) Hotoro G.R.A./Shehu Kazaure Road (East of Kofar Wambai central area), (P) Bata North West of the metropolis), (Q) Kurmi market (the central area of the metropolis), (R) G.R.A. II (East of the metropolis), (S) Central Hotel Roundabout (East of the Niger Motors LTD), (T) Bank road Roundabout (North of the metropolitan police MTD) and (U) Tamandu close G.R.A (West of Nasarawa Hospital Metro Council). Ambient gaseous waste emission in the sampled area were measured at three different times of the day (i.e. morning at 7:00 am, afternoon at 2:00 pm and in the evening at 6:00 pm local time). The daily mean was then calculated and presented in Table 1. The Crowcon Gas-Man detector used for the collection of data is a simple ON and OFF device which reads the concentration level of particular gas available at a particular area in ppm (± 0.01)

RESULTS AND ANALYSIS

Carbon monoxide: The level of concentration of Carbon I Oxide in all the sites (Table 1) does not exceed the standard limit approved by the Federal Ministry of Environment and WHO i.e. (10.00ppm).

Ammonia: The standard limit of ammonia from the Federal Ministry of Environment/WHO is (1.00ppm). The level of emission concentration of ammonia at site A is 2.00ppm which is on the higher side, whereas the remaining sites are all within the standard limits of l.00ppm of the WHO maximum limit. This implies that people living within this site are liable to be affected by the excess NH_3 gas.

Nitrogen dioxide: From Table 1 it can be observed that all the sites listed are within the standard of emission of the Federal Ministry of environment/WHO in respect to NO_2 emissions i.e. 0.09 ppm . Also, due to temperature difference and traffic congestion some sites have higher value than the others varying from 0.00 ppm to 0.06 ppm.

Table 1: Kano Metropolis Air Quality

LABEL	SITE NAME	TIME	CO ± 0.01 ppm	H_2S ± 0.01 ppm	CH_4 ± 0.01 ppm	NH_3 ± 0.01 ppm	NO_2 ± 0.01 ppm	SO_2 ± 0.01 ppm
A.	Gidan Murtala round about	Morning	7.00	1.00	1.00	2.00	0.05	0.06
		Afternoon	8.00	1.00	2.00	2.00	0.06	0.06
		Evening	8.00	2.00	1.00	2.00	0.06	0.06
		MEAN	**7.67**	**1.33**	**1.33**	**2.00**	**0.06**	**0.06**
B.	Murtala Muhammed road Kasuwan Rimi	Morning	7.00	0.60	1.33	1.00	0.10	0.10
		Afternoon	7.33	0.66	1.33	1.00	0.10	0.10
		Evening	7.50	0.65	1.34	1.00	0.10	0.10
		MEAN	**7.28**	**0.63**	**1.33**	**1.00**	**0.10**	**0.10**
C.	Nassarawa Matanfada Road	Morning	0.30	0.40	0.20	0.00	0.00	0.00
		Afternoon	0.33	0.66	0.66	0.00	0.00	0.00
		Evening	0.33	0.60	0.40	0.00	0.00	0.00
		MEAN	**0.32**	**0.55**	**0.42**	**0.00**	**0.00**	**0.00**
D.	Sani Abacha Way	Morning	7.60	1.00	1.00	0.00	0.06	0.05
		Afternoon	7.66	1.00	2.00	0.00	0.06	0.06
		Evening	7.80	1.00	1.00	0.00	0.06	0.05
		MEAN	**7.69**	**1.00**	**1.33**	**0.00**	**0.06**	**0.05**
E.	Zungeru /Airport Road	Morning	6.60	1.00	1.30	1.20	0.03	0.00
		Afternoon	6.66	1.00	1.33	1.33	0.03	0.00
		Evening	6.67	1.00	1.30	1.34	0.03	0.00
		MEAN	**6.64**	**1.00**	**1.31**	**1.29**	**0.03**	**0.00**
F.	G.R.A. I	Morning	0.60	0.33	0.30	0.00	0.03	0.00
		Afternoon	0.66	0.33	0.33	0.00	0.03	0.00
		Evening	0.66	0.33	0.33	0.00	0.03	0.00
		MEAN	**0.64**	**0.33**	**0.32**	**0.00**	**0.03**	**0.00**
G.	Ring road	Morning	1.60	1.00	1.30	1.00	0.01	0.10
		Afternoon	1.67	1.00	1.33	1.00	0.01	0.10
		Evening	1.66	1.00	1.33	1.00	0.01	0.10
		MEAN	**1.64**	**1.00**	**1.32**	**1.00**	**0.01**	**0.10**
H.	Ahmed Bello/Hadeja Road	Morning	1.60	1.00	0.33	0.10	0.01	0.10
		Afternoon	1.66	1.00	0.33	0.10	0.01	0.10
		Evening	1.66	1.00	0.33	0.10	0.01	0.10
		MEAN	**1.64**	**1.00**	**0.33**	**0.10**	**0.01**	**0.10**
I.	Sokoto Road	Morning	1.00	0.00	1.00	0.00	0.00	0.00
		Afternoon	0.00	0.00	0.00	0.00	0.00	0.00
		Evening	0.00	0.00	1.00	0.00	0.00	0.00
		MEAN	**0.33**	**0.00**	**0.66**	**0.00**	**0.00**	**0.00**

LABEL	SITE NAME	TIME	$CO \pm 0.01$ ppm	$H_2S \pm 0.01$ ppm	$CH_4 \pm 0.01$ ppm	$NH_3 \pm 0.01$ ppm	$NO_2 \pm 0.01$ ppm	$SO_2 \pm 0.01$ ppm
J.	State Road	Morning	4.00	1.00	1.00	0.00	0.02	0.10
		Afternoon	6.00	2.00	1.00	0.00	0.01	0.00
		Evening	7.00	0.00	1.00	0.00	0.00	0.00
		MEAN	**5.66**	**1.00**	**1.00**	**0.00**	**0.01**	**0.03**
K.	Dangi Roundabout	Morning	6.00	0.00	2.00	0.00	0.03	0.00
		Afternoon	00	0.00	2.00	0.00	0.02	0.10
		Evening	6.00	0.00	2.00	0.00	0.00	0.00
		MEAN	**6.66**	**0.00**	**2.00**	**0.00**	**0.01**	**0.00**
L.	Justice Dahiru Mustafa Road	Morning	0.00	0.00	0.10	0.00	0.01	0.00
		Afternoon	0.00	0.00	0.10	0.00	0.01	0.10
		Evening	0.00	0.00	0.10	0.00	0.01	0.00
		MEAN	**0.00**	**0.00**	**0.10**	**0.00**	**0.01**	**0.03**
M.	Gyadi-gyadi round about	Morning	5.00	1.00	2.00	0.00	0.01	0.00
		Afternoon	8.00	1.00	2.00	0.00	0.01	0.00
		Evening	7.00	1.00	2.00	0.00	0.01	0.00
		MEAN	**6.66**	**1.00**	**2.00**	**0.00**	**0.01**	**0.00**
N.	Maiduguri roundabout	Morning	4.00	1.00	2.00	1.10	0.02	0.01
		Afternoon	3.00	1.00	1.00	0.00	0.01	0.01
		Evening	5.00	1.00	1.00	0.00	0.01	0.01
		MEAN	**4.00**	**1.00**	**1.33**	**0.36**	**0.01**	**0.01**
O.	Hotoro G.R.A/Shehu Kazaure Road	Morning	1.00	1.00	0.00	0.00	0.01	0.01
		Afternoon	1.00	0.00	0.00	0.00	0.01	0.01
		Evening	1.00	0.00	0.00	0.00	0.01	0.01
		MEAN	**1.00**	**0.33**	**0.00**	**0.00**	**0.01**	**0.01**
P.	Bata	Morning	1.00	2.00	2.00	1.00	0.01	0.00
		Afternoon	1.00	1.00	2.00	0.00	0.00	0.00
		Evening	1.00	1.00	2.00	0.00	0.00	0.00
		MEAN	**1.00**	**1.33**	**2.00**	**0.33**	**0.00**	**0.00**
Q.	Kurmi Market	Morning	2.00	1.00	1.00	0.00	0.01	0.01
		Afternoon	1.00	1.00	1.00	1.00	0.01	0.01
		Evening	2.00	1.00	2.00	2.00	0.01	0.00
		MEAN	**1.66**	**1.00**	**1.33**	**1.00**	**0.01**	**0.01**
R.	G.R.A.II	Morning	0.00	1.00	0.00	0.00	0.01	0.00
		Afternoon	0.00	0.00	0.00	0.00	0.01	0.00
		Evening	0.00	0.00	0.00	0.00	0.01	0.00
		MEAN	**0.00**	**0.33**	**0.00**	**0.00**	**0.01**	**0.00**
S.	Central Hotel round about	Morning	8.00	2.00	2.00	0.00	0.01	0.01
		Afternoon	8.00	1.00	2.00	1.00	0.02	0.00
		Evening	6.00	0.00	2.00	0.00	0.02	0.00
		MEAN	7.33	1.00	2.00	0.33	0.01	0.00
T.	Bank Road roundabout	Morning	5.00	2.00	1.00	1.00	0.01	0.01
		Afternoon	8.00	2.00	1.00	0.00	0.02	0.00
		Evening	6.00	1.00	1.00	1.00	0.02	0.00
		MEAN	**6.33**	**1.66**	**1.00**	**0.66**	**0.01**	**0.00**
U.	Tamandu close G.R.A.	Morning	1.00	1.00	1.00	0.00	0.01	0.00
		Afternoon	1.00	1.00	1.00	0.00	0.01	0.00
		Evening	1.00	1.00	1.00	0.00	0.01	0.00
		MEAN	**1.00**	**1.00**	**1.00**	**0.00**	**0.01**	**0.00**

Sulfur dioxide (SO_2): According to the WHO and Federal Ministry of environment the standard limit of emission of SO_2 is 0.50 ppm. Based on the result presented in Table 1 it can be observed that the level of emission of sulfur dioxide is within the standard limit for all the sites (varying from 0.00 to 0.10 ppm). But due to the fact that we have dense population and too much of traffic in some areas than others, some areas such as Murtala Mohammed road kasuwan rimi have more emission concentration of the gas than Nasarawa/Matan fada road.

CONCLUSION

Based on the results obtained, the amount of gaseous waste such as H_2S, CH_4, NO_2, SO_2 generated in the study area are within the WHO allowable standard limit of 5.00, 5.00, 0.09 and 0.2 ppm respectively, therefore the amount of gases generated have no serious effect on the people living in the environment. As for NH_3 gas the result indicated that it exceeded the WHO limit especially on site labeled A (Gidan Murtala roundabout). Although the level of CO is not above the standard WHO limit of 10.00 ppm, but it is close to at some sites e.g. A, B, D and S. Owing to the high level of commercial activities on these sites caution is needed. Most importantly, the measured values indicated that in the afternoon and evenings when human activities are high the level of these pollution gasses rise.

REFERENCES

Adeyomey, A. B. (2002). *Community Health Preventive Medicine and Social Services*, University press, Ibadan Nigeria.

Agrawark, S. K. (1999). *Pollution Ecology*, Hamashu Publication (Rajasthan).

Akinsola, A. H. (1993). *A to Z Community Health and Social Medicine in Medical and Nursing Practice*, University press, Ibadan Nigeria

Ball, D. J. (1984). Environmental Implications of Increasing Particulate Emissions Resulting from Diesel Engine Penetration of the European Automobile Market *Science of the Total Environ* 33, pp. 15-30.

Bange, H. W., Rapsomanikis, S. and Andreae, M. O. (1996). The Aegean Sea as Source of Atmospheric Nitrous oxide and methane, *Marine Chemistry*, 53, pp 41–49

EPA (1993). Environmental Protection Agency Report to Congress on Hydrogen Sulfide Air

Emissions Associated with the Extraction of Oil and Natural gas, Research Triangle Park, NC, US EPA, Office of Air Quality Planning and Standards (EPA/453/R93045; NTIS Publication No. PB941312240).

EPA (1989). Environmental Protection Agency, Summary Review of Health Effects Associated with Ammonia. Washington, DC, US (EPA/600/8-89/052F).

Federal Ministry of Environment (1991). Federal Republic of Nigeria Official Gazette on Federal Environmental Protection Agency 20th August 1991.

Hill, F.B. (1973). Atmospheric Sulfur and its Links to the Biota, *Brookhaven Symposia in Biology*, 30, 159–181.

Ladigbolu, I.A., Balogun, K.J., Shelle, R.O., Oshisanya, K.I., Ajani, G.E. and Olumodaji, O.O. (2010). Impacts of Effluent Discharged by Industries Situated in Ibeshe, Lagos Lagoon, Nigeria on Heavy Metals Status of Surface Water, sediments and Fish, *International Journal of Physical Science*, 2(6) 87-95.

Miller, Y. C. Woodland, O. (2006). *A State Strategies for the Control and Prevention of Environmental Pollution* 2nd edition, McGraw Hill New York.

WHO (2004). World Health Organization Technical Report series 747 : Prevention and Control of Occupational Hazards.

Wilson, L.G., Bressan, R.A. and Filner, P. (1978). Light-dependent Emission of Hydrogen Sulfide from Plants, *Plant Physiology*, 61: 184–189.