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The Prophylactic Efficacy of Roselle [*H. sabdariffa*], Moringa [*Moringa oleifera*], Ginger [*Z. officinale*] and Ugwu [*T. occidentalis*] on the Hematology and Serum Protein of Albino Rats [*Rattus norvegicus*] Exposed to Cement Dust

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ABSTRACT

The bio-protective efficacy of medicinal plants on cells, organs and systems of animals living in industrial societies were assessed. The prophylactic efficacy of Roselle, Moringa, Ginger, Ugwu and their mixture on the hematology and serum protein of albino rats exposed to cement dust were evaluated. Albino rats, grouped into six comprising ten rats per group, were exposed to cement dust at about 200 m from a cement factory. The control group (group 1) was given distilled water, while the test groups (groups 2-6) were given extracts of Roselle, Moringa, Ginger, Ugwu and the mixture of their extracts, respectively. The rats had access to pellet feeds and water *ad libitum* and were monitored daily for 180 days. The hematology and blood serum analysis of the test rats showed significant ($p<0.05$) healthy conditions of the packed cell volume, hemoglobin, red blood cells, white blood cells and serum protein compared to the control rats. Furthermore, the blood of the control rats had time-dependent microcytosis, macrocytosis, anisocytosis, hypochromasia, lymphocytosis and eosinophilia. However, the blood of the test rats showed normal to mild anemic conditions observed in the control rats. The results of the study highlight the efficacy and effectiveness of medicinal plants in disease prevention and control. It also calls for various governments' participation in medicinal plant research by way of funding.

Key words: Cement dust, medicinal plants, hematology, albino rats, chemo-protective, hemoglobin, microcytosis

INTRODUCTION

The use of plants to cure diseases is as old as mankind. Archaeologists have found evidence of plants being used for medical purposes in almost every discovery as far back as the time of the first cavemen (Power, 2010). However, plant medicine practically vanished with the evolution of modern medicine and synthetic drugs. Moreover, due to the side effects and high cost of synthetic drugs, there is a renewed interest in plant medicine. Plant medicine is gaining global attention attributable to its effectiveness and affordability. The blind dependence on synthetic drugs is over and people are returning to plant medicine because it symbolizes safety in contrast to synthetic drugs (Joy *et al*., 2010).

Interestingly, plant medicine rebirth is happening at a time when the world is battling with the problems of environmental pollution, specifically industrial pollution. Several methods, mainly

prevention and control strategies, have been used in the past to clean the environment of toxins but most of these strategies have not recorded satisfactory success. The failures of these strategies are due to paucity of funds and strategy technicalities, ignorance, weak environmental laws and non-disclosure attitude of some environment polluters, mostly in developing countries (Tajudeen *et al*., 2011). From archaeological records, some plants such as milk-thistle (*Silybum, marianum*), red clover (*Trifolium, pratence*) and dandelion (*Taraxacum, officinale*) have been used in the past to prevent or purge the body of some toxins (Mindell, 1992).

The cement industry is one of the seventeen most environmental polluting industries in the world listed by the United States Central Pollution Control (Raajasubramanian *et al*., 2011). The major negative impacts of cement industry are the emissions of dust and gases (Bilen, 2010). Cement dust is a by-product of the final cement which is usually stored as wastes in open pits or landfills. The basic constituents of cement dust are calcium, iron, aluminum, silicon and manganese (Gbadebo and Bankole, 2007; Fell *et al*., 2010; Akpan *et al*., 2011). However, the calcinations and burning process of cement, especially the ones using hazardous wastes as fuels, produce heavy-metals, chromium, dioxins and greenhouse gases (IPC, 1996; Yahaya and Okpuzor, 2011). These elements are known to be toxic, mutagenic and carcinogenic (Meo, 2004) and have been implicated in respiratory diseases, genetic problems, multi-organ damage, cancers and hematological problems (Akinola *et al*., 2008; Leem *et al*., 2008; Mohammad and Sambo, 2008; Zeleke *et al*., 2010). Consequently, this study was designed to evaluate the prophylactic efficacy of Roselle, Moringa, Ginger, Ugwu and their mixture on the hematological parameters of albino rats exposed to cement dust.

MATERIALS AND METHODS

Duration of study: The research commenced in mid May, 2010 and finished in early March, 2011.

Animal husbandry: Seventy-two albino rats (*Rattus norvegicus*) weighing between 185 and 200 g were obtained from Biochemistry Department, University of Ibadan, Nigeria. The rats were maintained under ambient temperature and humidity and 12 h light/dark cycle for seven days at the factory site before the commencement of the study. The rats were administered with pellet feeds from F.A. Feeds, Lagos and water *ad libitum*.

Plant samples: The plant materials Roselle [*Hibiscus sabdariffa* Linn], Moringa [*Moringa oleifera* Lam], Ginger [*Zingiber officinale* Roscoe] and Ugwu [*Telfairia occidentalis* Hook-f] were obtained from Lagos Metropolitan market in May, 2010. They were identified at the Department of Pharmacology, University of Lagos and voucher specimens deposited. Roselle, known as Zobo in Nigeria, belongs to the family Malvacea, while Moringa, otherwise known as drumstick belongs to the family Morigacea. Ginger belongs to the family Zingiberaceae, while Ugwu, known as fluted pumpkin, belongs to the family Cucurbitacea.

Preparation of the extracts of the plant samples: Fresh leaves of the plant materials were washed gently to remove impurities and air-dried under shades for one week. The dried leaves were milled into powder using laboratory mill, Norris Limited Poole, England at the Department of Pharmacognosy, University of Lagos. In addition to the powder of individual plant materials produced, the mixture of the plant materials was also produced by mixing the four ground plant materials in ratio 1:1:1:1. The ground plant materials were then stored in desiccators prior to use.

Preparation of the extracts of the plants samples: Fifty grams of the powder of each plant sample and powder of their mixture were dissolved in 500 mL of 95% ethanol for 72 h. The extracts obtained were filtered with muslin clothes and evaporated to dryness at a temperature of 40°C. The ethanolic extraction of the powder of the plant samples produced 6.6, 6.5, 6.2, 5.9 and 6.1 g dry extracts of Roselle, Moringa, Ginger, Ugwu and the mixture of the plant samples, respectively. These dried extracts were reconstituted in 500 mL of water and serve as the decoction used for the experiment.

Determination of acute toxicity of the extracts: The acute toxicity test [LD_{50}] of the plants extracts were carried out according to the methods of Gabriel *et al*. (2008) using 30 albino rats in 6 group with 5 rats per group.

Study design: The albino rats (n = 72) were grouped into six comprising ten rats per group and were exposed to cement dust at about 200 m from West African Portland Cement Company, Sagamu, Nigeria. The baselines of the rats were taken before the exposure with regards to the hematology and serum protein of the rats. The results of the baselines of the rats shall be referred to as 0 day reading in this study. The control group (group 1) was administered with distilled water, while the test groups (groups 2-6) were fed with the extracts of Roselle, Moringa, Ginger and Ugwu, respectively. Group 6 in the test groups was administered with the extract of the mixture of the plant samples. The rats had access to pellet feeds from F.A. Feeds, Lagos and water *ad libitum* and were monitored daily for 180 days. The rats were then moved to the Hematology and Biochemistry Department, National Institute of Medical Research, Yaba, Lagos, where hematological parameters and serum protein contents of the rats were analyzed.

Examination of hematological parameters and serum protein: The rats were sedated with chloroform in the laboratory. Total death was prevented for proper blood collection. Each rat was pinned down firmly on a work bench. Surgical blades were used to cut through the chest region of the rat in a dorsal-vertical direction. The blood was then collected from beating hearts using Na Heparinized capillary-tube through capillarity into EDTA bottles. EDTA serves as anti-coagulated and also the Na Heparin in the capillary-tubes. The hematological parameters (PCV, HB, WBC and RBC) were determined using Sysmex auto-analyzer, while the total protein was determined from the blood plasma using VET 360 Veterinary Refractometer (Phoenix series).

Statistical analysis: A database file was created in a personal computer. All statistical analysis was carried out using the Statistical Package for Social Sciences (SPSS) version 17 for Windows and Microsoft Office Excel 2007. Comparisons of data among control and test groups were calculated using Student's t-test. The $p<0.05$ was considered statistically significant.

RESULTS

Table 1-5 showed the results of the effects of the plant extracts on the blood parameters of the exposed rats. The results showed a significant [$p<0.05$] improvement in the blood parameters of the test rats compared to the control rats. For example, in Table 1, the minimum and maximum PCV values [%] of the control rats are 23.41 and 39.81, respectively. The mean PCV change is 15.7 whereas the minimum and maximum PCV values of the rats fed with Roselle, Moringa, Ginger,

Table 1: The PCV (%) of the exposed rats fed with the extracts

	Day										
Extract	0	30	60	90	120	150	180	Minimum value	Maximum value	Mean change	p-value
Control	39.10±0.18^a	37.20±0.12^b	35.50±0.76^a	32.20±0.11^b	30.40±0.73^a	26.40±0.10^b	23.60±0.47^a	23.41	39.81	15.70	<0.0001*
Roselle	38.30±0.86^a	37.70±0.36^a	36.40±0.42^b	35.00±0.21^a	34.30±0.47^a	33.20±0.90^a	32.80±0.72^a	32.21	39.21	6.10	<0.0001*
Moringa	39.00±1.17^a	37.70±0.63^a	37.50±0.60^a	37.40±0.58^a	37.00±0.81^a	36.80±0.54^a	36.00±0.31^a	35.21	40.22	3.00	<0.0001*
Ginger	39.10±0.62^a	37.50±0.61^b	36.70±0.48^b	35.20±0.67^a	34.70±0.36^a	33.60±0.32^b	32.30±0.11^a	32.20	39.50	6.80	<0.0001*
Ugwu	39.00±0.80^a	38.10±0.13^a	37.75±0.23^a	37.80±0.24^a	37.20±0.33^a	37.00±0.58^a	36.30±0.34^a	35.99	39.91	2.70	<0.0001*
Mixture	39.30±0.56^a	39.20±0.57^a	39.10±0.48^b	38.90±0.51^a	38.30±0.60^a	38.70±0.61^a	38.30±0.61^a	37.22	39.91	1.00	<0.0001*

Data are expressed as Mean±SD, When *p<0.05 = Significant from control and when **p>0.05 = Not significant from control, Mean values with different superscripts along the same row are significantly different at p<0.05

Table 2: The HB (g dL^{-1}) of the exposed rats fed with the extracts

	Day										
Extract	0	30	60	90	120	150	180	Minimum value	Maximum value	Mean change	p-value
Control	13.20±0.29^a	12.40±0.13^b	11.80±0.27^a	10.80±0.05^b	10.10±0.27^a	8.83±0.06^b	7.92±0.15^a	8.80	13.33	5.30	<0.0001*
Roselle	12.82±0.10^a	12.40±0.10^a	12.10±0.14^b	11.71±0.07^a	11.43±0.16^a	11.12±0.30^a	10.90±0.23^a	10.80	13.10	1.90	<0.0001*
Moringa	13.03±0.39^a	12.61±0.10^a	12.53±0.20^a	12.50±0.19^a	12.31±0.27^a	12.29±0.18^a	12.02±0.10^a	12.10	13.40	1.01	<0.0001*
Ginger	13.01±0.21^a	12.50±0.20^b	12.21±0.16^b	11.72±0.02^a	11.60±0.12^a	11.20±0.11^b	10.81±0.04^a	10.70	13.20	2.20	<0.0001*
Ugwu	13.00±0.27^a	12.70±0.04^a	12.61±0.08^a	12.60±0.08^a	12.40±0.11^a	12.31±0.20^a	12.10±0.11^a	12.00	13.30	0.90	<0.0001*
Mixture	13.10±0.18^a	13.10±0.19^a	13.01±0.16^a	13.00±0.17^a	12.93±0.20^a	12.90±0.20^a	12.83±0.20^a	12.40	13.30	0.30	<0.0001*

Data are expressed as Mean±SD, When *p<0.05 = Significant from control and when **p>0.05 = Not significant from control, Mean values with different superscripts along the same row are significantly different at p<0.05

Ugwu and their mixture are 32.21, 35.21, 32.20, 35.99, 37.22 and 39.21, 40.22, 39.50, 39.91, 39.91, respectively. The mean PCV change of Roselle, Moringa, Ginger, Ugwu and their mixture are 6.1, 3.0, 6.8, 2.7 and 1.00, respectively. In Table 2, the minimum and maximum values of HB [g dL^{-1}] of the control rats are 8.80 and 13.33, respectively. The mean HB change of the control rats is 5.3. However, the minimum and maximum HB values of the rats administered with Roselle, Moringa, Ginger, Ugwu and their mixture are 10.80, 12.10, 10.70, 12.00, 12.40 and 13.1, 13.40, 13.20, 13.30, 13.30, respectively, while their mean HB changes are 1.90, 1.01, 2.20, 0.90 and 0.30 for Roselle, Moringa, Ginger, Ugwu and their mixture, respectively. Table 3 showed the RBC values [$\times 10^{12}$] of the exposed rats where the minimum and maximum values of the control rats are 3.40 and 4.43, respectively. The mean RBC change of the control is 0.8. The minimum and maximum RBC values of the rats fed with Roselle, Moringa, Ginger, Ugwu and their mixture are 3.78, 4.04, 3.82, 4.13, 4.12 and 4.41, 4.40, 4.35, 4.33, 4.32, respectively. The mean RBC changes are 0.5, 0.2, 0.5, 0.2 and 0.1, respectively. Moreover, the minimum and maximum WBC values [mm^3] of the control rats as shown in Table 4 are 4735 and 6713, respectively. The mean WBC change of the control rats is 1594. However, the minimum and maximum WBC values of the rats fed with Roselle, Moringa, Ginger Ugwu and their mixture are 4632, 4689, 4658, 4743, 4751 and 5501, 6058, 5146, 5098, 5161, respectively. The mean WBC changes are 542, 491, 272, 148 and 144, respectively. Finally, in Table 5, the minimum and maximum Serum Protein values [g dL^{-1}] of the control rats are 6.03 and 6.91, respectively. The mean serum protein change of the control rats is 0.97. But the minimum and maximum serum protein values of the rats fed with Roselle, Moringa, Ginger, Ugwu and their mixture are 6.10, 6.55, 6.03, 6.62, 6.63 and 6.93, 6.95, 6.94, 6.98, 6.81, respectively. The mean serum protein changes are 0.84, 0.23, 0.79, 0.17 and 0.04, respectively.

Table 3: The RBC ($x10^{12}$) of the exposed rats fed with the extracts

	Day										
Extract	0	30	60	90	120	150	180	Minimum value	Maximum value	Mean change	p-value
Control	4.30±0.12^{a}	4.05±0.13^{b}	13.88±0.13^{a}	3.77±0.10^{b}	3.64±0.06^{a}	3.52±0.10^{b}	3.46±0.14^{a}	3.40	4.43	0.8	<0.0013*
Roselle	4.32±0.09^{a}	4.25±0.06^{a}	4.16±0.06^{a}	4.06±0.07^{a}	3.97±0.07^{a}	3.89±0.02^{a}	3.79±0.01^{a}	3.78	4.41	0.5	<0.016*
Moringa	4.29±0.13^{a}	4.26±0.12^{a}	4.23±0.09^{a}	4.19±0.09^{a}	4.15±0.07^{a}	4.12±0.03^{a}	4.09±0.04^{a}	4.04	4.40	0.2	<0.0018*
Ginger	4.31±0.04^{a}	4.28±0.06^{a}	4.22±0.06^{a}	4.14±0.06^{a}	4.03±0.05^{a}	3.94±0.04^{b}	3.85±0.04^{a}	3.82	4.35	0.5	<0.0094*
Ugwu	4.31±0.02^{a}	4.27±0.03^{a}	4.23±0.03^{a}	4.20±0.03^{a}	4.18±0.03^{a}	4.15±0.02^{a}	4.14±0.01^{a}	4.13	4.33	0.2	<0.0011*
Mixture	4.27±0.08^{a}	4.26±0.08^{a}	4.26±0.08^{a}	4.23±0.07^{a}	4.21±0.07^{a}	4.19±0.06^{a}	4.18±0.05^{a}	4.12	4.32	0.1	<0.0011*

Data are expressed as Mean±SD, When *p<0.05 = Significant from control and when **p>0.05 = Not significant from control, Mean values with different superscripts along the same row are significantly different at p<0.05

Table 4: The WBC (mm^{3}) of the exposed rats fed with the extracts

	Day										
Extract	0	30	60	90	120	150	180	Minimum value	Maximum value	Mean change	p-value
Control	4833±99.1^{a}	4955±87.1^{a}	5137±106^{a}	5406±183^{a}	5684±137^{a}	6100±133^{a}	6427±253^{a}	4735	6713	1594	0.0005*
Roselle	4862±204^{a}	4988±233^{a}	5061±201^{a}	5163±193^{a}	5307±162^{a}	5404±159^{a}	5534±107^{a}	4632	5501	542	0.0049*
Moringa	4884±174^{a}	4954±195^{a}	5296±632^{a}	5335±603^{a}	5344±604^{a}	5359±603^{a}	5375±600^{a}	4689	6058	491	0.049*
Ginger	4767±96^{a}	4825±112^{a}	4850±133^{a}	4890±148^{a}	4920±147^{a}	4948±139^{b}	5039±133^{a}	4658	5146	272	0.0011*
Ugwu	4845±104^{a}	4884±100^{a}	4910±105^{a}	4933±103^{a}	4932±102^{a}	4969±104^{a}	4993±100^{a}	4743	5098	148	0.0008*
Mixture	4900±134^{a}	4936±136^{a}	4960±148^{a}	4980±148^{a}	5002±150^{a}	5018±150^{a}	5089±145^{a}	4751	5161	144	0.0012*

Data are expressed as Mean±SD, When *p<0.05 = Significant from control and when **p>0.05 = Not significant from control, Mean values with different superscripts along the same row are significantly different at p<0.05

Table 5: The Serum protein (g dL^{-1}) of the exposed rats fed with the extracts

	Day										
Extract	0	30	60	90	120	150	180	Minimum value	Maximum value	Mean change	p-value
Control	6.84±0.10^{a}	6.54±0.78^{a}	6.39±0.78^{a}	6.28±0.04^{a}	6.16±0.40^{a}	6.06±0.03^{a}	5.87±0.03^{a}	6.03	6.91	0.97	<0.0001*
Roselle	6.84±0.12^{a}	6.70±0.13^{a}	6.57±0.16^{a}	6.42±0.27^{a}	6.24±0.08^{a}	6.14±0.04^{a}	6.00±0.04^{a}	6.10	6.93	0.84	<0.0012*
Moringa	6.78±0.015^{a}	6.74±0.13^{a}	6.70±0.14^{a}	6.69±0.12^{a}	6.64±0.12^{a}	6.60±0.08^{a}	6.55±0.04^{a}	6.55	6.95	0.23	<0.0001*
Ginger	6.85±0.11^{a}	6.73±0.10^{a}	6.62±0.10^{a}	6.49±0.08^{a}	6.30±0.05^{a}	6.16±0.03^{b}	6.06±0.03^{a}	6.03	6.94	0.79	<0.0012*
Ugwu	6.83±0.14^{a}	6.78±0.12^{a}	6.76±0.11^{a}	6.74±0.09^{a}	6.71±0.08^{a}	6.68±0.06^{a}	6.66±0.05^{a}	6.62	6.98	0.17	<0.0001*
Mixture	6.75±0.06^{a}	6.74±0.06^{a}	6.73±0.07^{a}	6.72±0.08^{a}	6.72±0.08^{a}	6.72±0.08^{a}	6.71±0.08^{a}	6.63	6.81	0.04	<0.0001*

Data are expressed as Mean±SD, When *p<0.05 = Significant from control and when **p>0.05 = Not significant from control, Mean values with different superscripts along the same row are significantly different at p<0.05

DISCUSSION

The effectiveness of the plant preparations at a dose of 400 mg kg^{-1} corroborates the report of Adedapo *et al.* (2009) that the extract of one of the medicinal plants under this study at the said dose has most significant effects on biochemical and hematological parameters of rats. The non-toxicity of the extracts also supports the assertions of Joy *et al.* (2010) that most plants are safe.

The marked reduction in the blood parameters and serum protein of the control rats is a confirmation of the earlier findings of Calistus Jude *et al.* (2002) and Tajudeen *et al.* (2011). They separately observed decrease in the blood parameters of humans and albino rats exposed to cement dust, respectively. The reduction in the blood parameters also supports the findings of Muhammad and Sambo (2008) who observed a reduction in the blood parameters of Nile Tilapia exposed to

cement dust in water. However, the results contradict the reports of Ogunbileje and Akinosun (2011) who observed increase in hematological parameters of cement factory workers. The results further confirm the observations of Akinola *et al.* (2008), Leem *et al.* (2008) and Zeleke *et al.* (2010) that cytotoxic reactions occurred between cement dust and various organs and systems of animals. The results also support the findings of Gbadebo and Bankole (2007), Ade-Ademilua and Obalola (2008), Fell *et al.* (2010) and Akpan *et al.* (2011) that cement dust contain toxic, carcinogenic and mutagenic elements. Moreover, the results support the reports of IPC (1996), Bilen (2010) and Raajasubramanian *et al.* (2011) that cement production is a great source of heavy metals and gases. Cases of hematological problems have been reported in humans after ingesting lethal or sub-lethal doses of Cr (VI) compounds. Decrease in PCV, HB, RBC and WBC were observed in an 18-year-old woman following ingestion of a few grams of Potassium dichromate which is an indicative of intracellular hemolysis (ATSDR, 2008). Furthermore, chromium in fresh water Teleost [*Cyprinus carpio*] has been observed to cause decreases in total protein due to renal excretion, impaired protein synthesis or impaired liver disorder (Paravath *et al.*, 2011). Lead has been fingered to cause basophilic stippling, nucleated RBC, decreased RBC, MCH and MCV in individual exposed. In addition, lead has been observed to cause anemia of micro-cytic and hypo-chromic type, probably due to cell metabolism alteration of the enzyme activity and the hem-biosynthesis disruption due to defects in iron metabolism (Mugahi *et al.*, 2003). Besides, lead has been implicated in decreased total protein of the blood serum, which may be attributed to damaged liver (Zaki *et al.*, 2010). The toxic effects of aluminum on blood parameters are mainly microcytosis, decreased mean corpuscular hemoglobin, decreased RBC, decreased hemoglobin and decreased serum iron. Nitrogen dioxide from poisonous gases emitted by kilns burning hazardous wastes may cause reduced red blood cells. Moreover, it may interfere with the hem-biosynthesis of the blood by converting a fraction of Fe^{+2} in the hemoglobin to Fe^{+3} causing methemoglobins and impaired oxygen transport (ATSDR, 2008, 2011).

The improvements observed in the hematological parameters and the serum protein of the test rats could be as a result of two things: one, the activities of the antioxidants in the plant extracts; and two, the rebuilding activities of nutrients and phytochemicals found in the plant extracts. This results support the findings of Mindell (1992) that medicinal plants contain phytochemicals which can purge toxins from human body. Roselle contains antioxidants such as gossypetine, hibiscetine and sadderetine which are actively involved in chemo-prevention. It also contains phytochemicals and nutrients such as riboflavin, niacin, calcium, iron and vitamin C which add nutrients to the rats (Fasoyiro *et al.*, 2005). The chemo-prevention antioxidants in Moringa are mainly the carotenoids-lutein, alpha-carotene, beta-carotene, xanthin and chlorophyll. It also contains minerals and nutrients, such as calcium, zinc, potassium, sodium, magnesium, all the vitamins and crude protein (Cajuday and Pocsidio, 2010). The oils from ginger, gingerol and eugenol, contain antioxidants such as polyphenol, flavonoids and total tannin which reduce or scavenge free radicals. It also contains vitamin C and some minerals (Shirin Adel and Prakash, 2010). Finally, Ugwu contains nicotinamide, riboflavin and vitamin C as antioxidants and it contains zinc, iron, magnesium, calcium, vitamin A and crude protein as nutrients (Salman *et al.*, 2008; Emeka and Obidoa, 2009). Generally, all the medicinal plants contain vitamin C (ascorbic acid) whose roles in ameliorating the effects of toxins on serum protein, bilirubins and blood parameters have been reported (Hamed, 2006).

CONCLUSION AND RECOMMENDATION

The results have shown that cement dust is toxic to animals, including man. Furthermore, medicinal plants especially the ones used in this study could be effective remedies for various diseases associated with environmental pollution. This is a wake-up call to various governmental agencies to show interest in medicinal plants research, especially their synergetic effects. This will go a long way in preserving the health of animals and humans living in industrial societies.

REFERENCES

ATSDR, 2008. Case studies in environmental medicine. http://www.atsdr.cdc.gov/csem/csem.html.

ATSDR, 2011. Medical management guidelines for nitrogen oxides. Toxic Substances Portal-Nitrogen Oxides. http://www.atsdr.cdc.gov/MMG/MMG.aspid = 394&tid = 69.

Ade-Ademilua, O.E. and D.A. Obalola, 2008. The effect of cement dust pollution on *Celosia argentea* (Lagos Spinach) plant. J. Environ. Sci. Technol., 1: 47-55.

Adedapo, A.A., O.M. Mogbojuri and B.O. Emikpe, 2009. Safety evaluations of aqueous extracts of the leaves of *Moringa oleifera* in rats. J. Med. Plants Res., 3: 586-591.

Akinola, M.O., N.A. Okwok and T. Yahaya, 2008. The effects of cement dust on albino rats (*Rattus norvegicus*) around West African portland cement factory in Sagamu, Ogun state, Nigeria. Res. J. Environ. Toxicol., 2: 1-8.

Akpan, I.O., A.E. Amodu and A.E. Akpan, 2011. An assessment of the major elemental composition and concentration in limestones samples from yandev and odukpani areas of Nigeria using nuclear techniques. J. Environ. Sci. Technol., 4: 332-339.

Bilen, S., 2010. Effects of cement dust pollution on microbial properties and enzyme activities in cultivated and no-till soils. Afr. J. Microbiol. Res., 4: 2418-2425.

Cajuday, L.A. and G.L. Pocsidio, 2010. Effects of *Moringa oleifera* Lam. (Moringaceae) on the reproduction of male mice (*Mus musculus*). J. Med. Plants Res., 4: 1115-1121.

Calistus Jude, A.L., K. Sasikala, R. Ashok Kumar, S. Sudha and J. Raichel, 2002. Hematological and cytogenic studies in workers occupationally exposed to cement dust. Int. J. Human Gen., 2: 95-99.

Emeka, E.J.I. and O. Obidoa, 2009. Some biochemical, haematological and histological responses to a long term consumption of *Telfairia occidentalis*-supplemented diet in rats. Pak. J. Nutr., 8: 1199-1203.

Fasoyiro, S.B., O.A. Ashaye, A. Adeola and F.O. Samuel, 2005. Chemical and storability of fruited flavoured (*H. sabdariffa*) drinks. World J. Agric. Sc., 1: 165-168.

Fell, K.M.A., L.I.B. Sikkeland, M.V. Svendson and J. Kongerad, 2010. Airway inflammations in cement production workers. Occup. Environ. Med., 67: 395-400.

Gabriel, O., N. Harrision, O. Okey and A. Ukoha, 2008. Changes in lipid and hematological profile of aqueous ethanolic extracts of *Alstonia boonei* in rats. Int. J. Hematol., Vol. 4.

Gbadebo, A.M. and O.D. Bankole, 2007. Analysis of potentially toxic metals in airborne cement dust around sagamu, Southwestern Nigeria. J. Applied Sci., 7: 35-40.

Hamed, M.A., 2006. Effect of vitamin C on serum protein profile in mice after aluminum sulphate intoxication. Pol. J. Food Nutr. Sci., 15: 339-348.

IPC, 1996. Review of IPC authorization and variations. Castle Cement Limited, Ribblesdale Works, Friends of the Earth Briefings, Integrated Pollution Control, Ireland.

Joy, P.P., J. Thomas, S. Mathew and B.P. Skaria, 2010. Medicinal Plants. In: Tropical Horticulture, Bose, T.K., J. Kabir, P. Das and P.P. Joy (Eds.). Vol. 2. Naya Prokash, Calcutta, India, pp: 449-632.

Leem, J., E. Lee, H. Kim and M. Kim, 2008. The health effects of chromium containing cement dust assessed by combined methods of epidemiological and toxicological approach. Epidemiology, 19: s230-s230.

Meo, S.A., 2004. Health hazards of cement dust. Saudi Med. J., 25: 1153-1159.

Mindell, E., 1992. Earl Mindell's Herb Bible. Simon and Schuster, New York, ISBN-13: 9780684849065, Pages: 304.

Mohammad, A.K. and A.B. Sambo, 2008. Hematological assessment of the Nile Tilapia *Oreochromis niloticus* exposed to sub-lethal concentrations of Portland cement powder in solution. Int. J. Zool. Res., 4: 48-52.

Mugahi, M.N, Z. Heidari, H.M. Sagheb and M. Barbarastani, 2003. Effects of chronic lead acetate intoxication on blood indices of male adult rat. Daru, 11: 147-151.

Ogunbileje, J.O. and O.M. Akinosun, 2011. Biochemical and haematological profile in Nigerian cement factory workers. Res. J. Environ. Toxicol., 5: 133-140.

Paravath, K, P. Sivakumar, M. Samesh and Sangsu, 2011. Sub-lethal effects of chromium on some biochemical profiles of the fresh water teleost, cyprinus carpio. Int. J. Appl. Bioc. Pharmaceutic. Technol., 2: 295-300.

Power, J., 2010. History of Aromatherapy. http://www.aromaweb.com/articles/history.asp

Raajasubramanian, D., P. Sundaramoorthy, L. Baskaran, K. Sankar Ganesh, Al.A. Chidambaram and M. Jeganathan, 2011. Cement dust pollution on growth and yield attributes of groundnut (*Arachis hypogaea* L.). Int. Multidiscipline Res. J., 1: 31-36.

Salman, T.M., L.A. Olayaki and W.A. Oyeyemim 2008. Aqueous extract of *T. occidentalis* leaves reduce blood sugar and increase hematological and reproductive indices in male rats. Afr. J. Biotechnol., 7: 2299-2303.

Shirin Adel, P.R. and J. Prakash, 2010. Chemical composition and antioxidants properties of ginger root (*Zingiber officinale*). J. Med. Plant Res., 4: 2674-2679.

Tajudeen, Y., J. Okpuzor and A.T. Fausat, 2011. Investigation of general effects of cement dust to clear the controversy surrounding its toxicity. Asian J. Sci. Res., 4: 315-325.

Yahaya, T. and J. Okpuzor, 2011. Variation in the degrees of exposure to cement dust in relation to distance from cement company. Res. J. Environ. Toxicol., 5: 203-212.

Zaki, M.S., S. Mastafa and I. Awad, 2010. Some studies of lead toxicity in marino sheep. J. Am. Sci., 6: 128-131.

Zeleke , Z.K., B.E. Meon and M. Bratveit, 2010. Cement dust exposure and acute lung function: A cross shift study. BMC. Pulmonary Med., 10: 19-19.