

Antioxidant property of methanolic extract of *Plumbago zeylanica* root on rats exposed to cement dust

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Abstract

This study reports ameliorative and antioxidant activity of methanolic extract of *Plumbago zeylanica* root in albino rats exposed to cement dust. A total of fifty-four (54) rats were randomly divided into six Groups of nine each. Group 1 was not exposed to cement dust and not treated, Group 2 was exposed to cement dust and not treated, Group 3 was exposed to cement dust and treated with DMSO (extract vehicle), Groups 4 and 5 were exposed to cement dust and treated with 17.5 and 35 mg/kg of the extract and Group 6 was exposed to cement dust and treated with vitamin C. The activities of superoxide dismutase (SOD), catalase and glutathione reductase and the levels of malondialdehyde in the serum of the rats were determined. Also, haematological parameters were determined in samples taken at 3 days, 7 days and 21 days exposure of the rats. The SOD, catalase and glutathione reductase activities were significantly decreased ($p < 0.05$) while the malondialdehyde levels significantly increased in all the rats exposed to cement dust while the extract (17.5 mg/kg body weight) and Vitamin C significantly increased the activities of SOD, catalase and glutathione reductase 3 days, 7 days and 21 days of administration and treatment. Malondialdehyde levels became reduced significantly in the extract-treated Groups and not significantly different ($p > 0.05$) from the normal control, DMSO- and the vitamin C-treated Groups. Distortions in the haematological parameters were also reversed in the extract-treated Groups. This study confirms that cement dust causes oxidative damage and that methanolic extract of *Plumbago zeylanica* root has in vivo antioxidant activities and ameliorates the oxidative stress induced by the cement dust in rats.

Keywords: Cement dust, lipid peroxidation, enzymatic antioxidants, air pollutants, chronic obstructive pulmonary diseases (COPD)

Introduction

Portland cement may be defined as a gray powder-like adhesive substance (Yang *et al.*, 1996). It may also be defined as mineral dust which when mixed with water forms a plaster like adhesive mass (Bazas, 1980). Cement is almost indispensable in the construction of concrete forms in buildings, buildings and other constructions. However, during manufacture of cement, enormous amount of cement dust is generated and released into the nearby environment. The continuous release of industrial waste such as cement dust into the atmosphere has been reported to be one of the great harms being done to the environment and the inhabitants. The cement industry is considered a major pollution source because of the dust and particulate matters emitted at the various levels of cement production. Cement dust consists of many toxic substances such as aluminum, nickel, cobalt, lead, chromium and silica which are hazardous to the biotic environment with adverse impact on vegetation, human and animal health and the ecosystem (Baby *et al.*, 2008)

Cement dust when inhaled triggers reactions in the cells leading to generation of free radicals in the body. These free radicals at an overwhelming level can induce oxidative stress which ultimately leads to lipid peroxidation in the lungs and other organs of the body. Resulting from this is the impairment of lung functions and chronic obstructive pulmonary diseases (Al-Neaimi *et al.*, 2001; Azah *et al.*, 2002). This problem has led to cement factory workers taking several protective measures. Although protective gears should be worn, reports have indicated that industries rarely provide precautionary measures and where provided it does not confer total protection against cement dust as significant amount still find ways into the lungs of workers through inhalation (Alakija *et al.*, 1990; Al-Neaimi *et al.*, 2001; Meo *et al.*, 2002). So a possible alternative is the administration of herbal mixtures with antioxidant properties that can ameliorate the effect of the exposure. One of such herbal plant with antioxidant potentials is *Plumbago zeylanica*. The ameliorative effect of aqueous root extract of *Plumbago zeylanica* was examined in this study.

Materials and Methods

Plant material:

Roots of *Plumbago zeylanica* was collected from a farmland in Ede, Osun State, Nigeria in October, 2015. It was authenticated at the Herbarium Unit, Department of Plant Biology, University of Ilorin, Kwara State.

Cement

Cement was obtained from a cement store along Asa Dam Road, Ilorin, Kwara State, Nigeria.

Chemicals

DPPH (1, 1-Diphenyl-2-picrylhydrazyl), ABTS (2, 2-azinobis-3-ethyl benzothiazoline-6-sulfonic acid diammonium salt), NaEDTA, nitroblue tetrazolium chloride (NBT), EDTA (Ethylene diamine tetra acetic acid), Ferric chloride, Methanol, Glutathione, hydrogen peroxide and all other chemicals used were all of analytical grade.

Preparation of the plant extract:

The dried roots of *Plumbago zeylanica* were oven dried at a temperature of 40°C for three weeks and coarsely powdered. The powdered material (1000 g) was macerated with 99 % v/v methanol at room temperature for a period of 3 days accompanied with occasional shaking and stirring. The whole mixture was then filtered and the filtrate obtained was concentrated by using a rotary evaporator (Bibby RE200, Sterlin Ltd, UK) to obtain a viscous mass. The viscous mass was then air-dried to a solid mass at 25 °C. The extract prepared was used for the study.

Phytochemical Screening of the Plant Extract

The root of *Plumbago zeylanica* was screened for the presence of phytochemicals such as flavonoids and total phenolics. The DPPH scavenging assay was also conducted to ascertain the level of antioxidant property of the plant. The total phenolics in the extract were determined based on Folin-Ciocalteu reagent assay (Singleton and Rossi *et al.*, 1965). Total flavonoid content was determined by the aluminum chloride colorimetric assay (Zhishen, *et al.*, 1999) and expressed as mg catechin equivalents (CE)/100 G fresh weights. All samples were analysed in triplicates. The DPPH radical scavenging assay was determined using quercetin as reference compound. The inhibition percentage (%) of radical

scavenging activity was determined as described by Burda and Oleszek *et al.* (2001). The percent inhibition was calculated as described by Shang-Tzen Chang (2001).

Animals and Treatments

Male albino rats weighing between 160 g - 200 g were used for the study. The animals were obtained from the animal house of the Department of Biochemistry, University of Ilorin. The animals were fed with standard feed and water *ad libitum*. Fifty-four (54) rats were divided into six groups of nine animals each. Group 1 was not exposed to cement dust, group 2 was not exposed to cement dust but treated with DMSO, group 3 was exposed to cement dust and treated with methanolic extract of *Plumbago zeylanica* root at 17.5 mg/kg body weight, group 4 rats were exposed to cement dust and treated with methanolic extract of *Plumbago zeylanica* root at 35 mg/kg body weight, group 5 rats were exposed to cement dust and treated with vitamin C at 17.5 mg/kg body weight, while group 6 were exposed to cement dust for 21 days, but not treated.

Procedure for exposure of the experimental animals to cement dust and extract administration

A dry plastic bottle, 50 ml capacity, with holes punctured at the cover containing 10 g of cement was used. The very small holes on the cover top of the container allowed the cement to come out as dust when pressure was applied on the bottle. For the induction of the animals the container which already contained 10 g of cement was placed in the animal cage measuring 24 x 18 x 12 cubic inches in dimension. A little pressure was applied with the two hands on the container. The cement dust was expelled through the small holes until the whole content was completely dispersed as dust into the animal cage. The cage was then covered with a piece of cloth for 30 s to prevent the cement dust from escaping from the container immediately and also to ensure maximum inhalation of the dust by the animals. This procedure was repeated until all the cement in the container got exhausted. This action was repeated after 48 hours for a total of 21 days from the beginning of administration.

The sneezing by the animals, restlessness and the rush for food and water after the exposure of the rats are characteristic responses displayed after inhaling the cement dust. A tangible amount of moist cement dust was also found deposited on the noses of the animals which may suggest mucus

secretion. After the exposure, the animals were left for 30 minutes before the extract was administered.

Preparation of Serum and Lungs Homogenate

The rats were sacrificed by cervical dislocation and blood was collected from the rats by jugular puncture. Serum was prepared by centrifugation for 10 minutes at 3000 x *g* in an MSC bench centrifuge (Bibby RE200, Sterlin Ltd, UK). The clear supernatant was used for the estimation of serum enzyme. The lungs were removed and rinsed in ice-cold 1.15% KCl and weighed. It was then homogenised in a Tris-sucrose buffer (10 mM Tris, 1.25 M Sucrose, 1 mM EDTA, pH 7.4). The homogenate was centrifuged at 10,000 x *g* for 20 minutes to obtain the supernatant fraction which is used in the assessment of Lipid peroxidation.

Haematological Parameter

Three rats were sacrificed from each group on the third day, seventh day and twenty-first day. Whole blood samples were collected from the animals into Na-EDTA bottles. The blood was used to estimate haematocrit (PCV), haemoglobin (Hb), red blood cell (RBC), mean cell volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC), white blood cell (WBC), total white blood cell (TWBC), differential white blood cells and platelets.

Determination of Lipid Peroxidation

Serum malondialdehyde (MDA) was determined using the procedure described by Reilly and Aust (2001).

Assessment of Antioxidant Enzyme Activity

Superoxide dismutase (SOD) and Catalase (CAT) were assayed as reported by Misra and Fridovich (1975) and Aebi (1984) respectively. Glutathione reductase was determined as described by Paglia and Valentine (1967).

Histological examination

Lungs samples were isolated from each Group and prepared for histological examinations as described by Krause (2001).

Statistical analysis

Data was analysed as Mean $\pm$ Standard error of mean (SEM). Statistical analysis was implemented using computer software SPSS 20.0 version statistical package program (SPSS, Chicago, IL). One-way analysis of variance was used to compare variables among the different Groups. Level of significance (Post hoc comparisons) differences among the various treatments was determined by Duncan's Multiple Range Test. Differences were considered statistically significant at $p < 0.05$.

Table 1: Secondary metabolite constituents of the *plumbago zeylanica* root extract

Alkaloids	+
Amino acids	+
Flavonoids	+
Glycosides	+
Phenolics	+
Saponins	+
Steroids	+
Tannins	+

Table 2: Total antioxidant capacity of methanolic extract of *Plumbago zeylanica* root

FRAP (mg/kg)	TOTAL PHENOLICS (mg/kg)	TOTAL FLAVONOIDS (mg/kg)	TOTALANTIOXIDANTS (mg/kg)
5150	18444.44	13047.62	270.9091
3950	18311.11	14063.49	180

Table 3: DPPH scavenging potentials of methanolic extract of *Plumbago zeylanica* root

µg/ml	(%) Inhibition
50	55.5655
40	55.4764
30	47.9074
20	47.6403
10	32.5913

The results of exposure to cement dust and the effect of extract and vitamin C on the exposed animals for the duration of 3 days, 7 days and 21 days on cytosolic superoxide dismutase catalase activities and glutathione reductase activity, haematological parameters as well as lipid peroxidation profile are shown in Figures 1 to 4.

The activity of superoxide dismutase and glutathione reductase in the normal and DMSO control groups were not significantly different ($p < 0.05$) for the period of 3 days, 7 days and 21 days. The activity of superoxide dismutase, catalase and glutathione in the cement-exposed group (untreated) decreased significantly ($p < 0.05$) in the decreasing order- 3 days > 7 days > 21 days when compared to the normal and the DMSO control groups with the highest decrease observed at the 21st day. But on administration of the extract at 17.5 mg/kg, the onslaught caused as a result of the exposure to cement dust was ameliorated significantly ($p < 0.05$). The extract at 17.5 mg/kg body weight could compete favourably with the reference drug (Vitamin C). The extract at 35 mg/kg body weight showed significant decrease ($p < 0.05$) in the activities of superoxide dismutase, catalase and glutathione concentration for the 3 days, 7 days and 21 days period of exposure to cement dust.

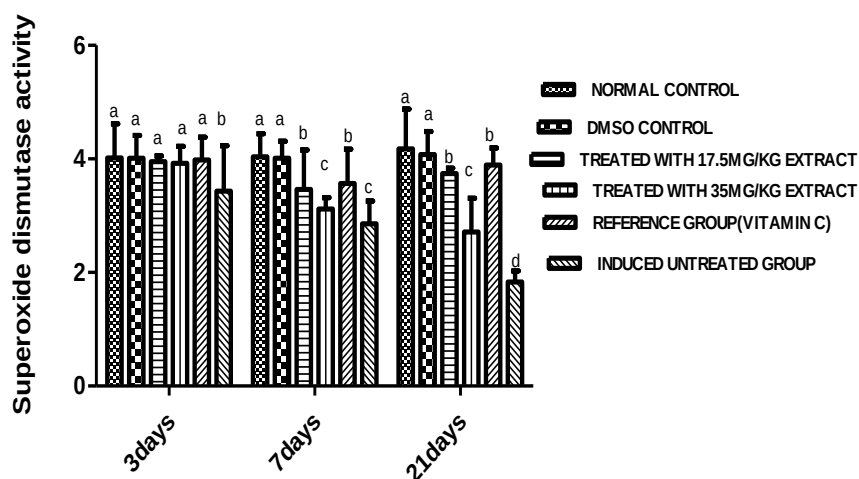


Figure 1: Superoxide dismutase activity in rats previously exposed to cement dust and treated with *P. zeylanica* root methanolic extract and vitamin C

Results are Mean $\pm$ SEM of three values. Values with superscript (alphabets) are statistically significant ($P < 0.05$)

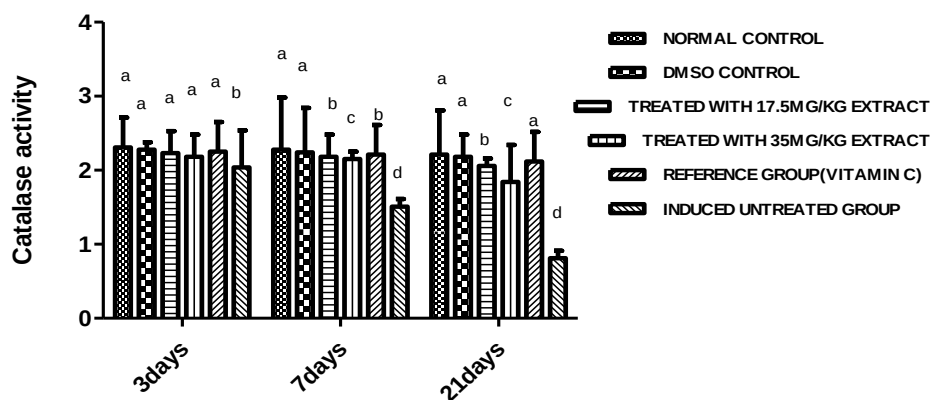


Figure 2: Catalase activity in rats previously exposed to cement dust and treated with *P. zeylanica* root methanolic extract and vitamin C

Results are Mean $\pm$ SEM of three values. Values with superscript (alphabets) are statistically significant ($P < 0.05$)

The malondialdehyde concentration in the normal control and DMSO control groups were not significantly different ($p < 0.05$). The malondialdehyde in the cement-exposed group (untreated) increased significantly in the order 3 days < 7 days < 21 days compared to the normal and DMSO treated groups. But on administration of the extract at 17.5 mg/kg body weight, the malondialdehyde concentration decreased significantly ($p < 0.05$) compared to the untreated group. The extract at 17.5 mg/kg compares closely with the reference drug (vitamin C). The extract at 35 mg/kg increased significantly ($p < 0.05$) the malondialdehyde concentration in the 7 days and 21 days period.

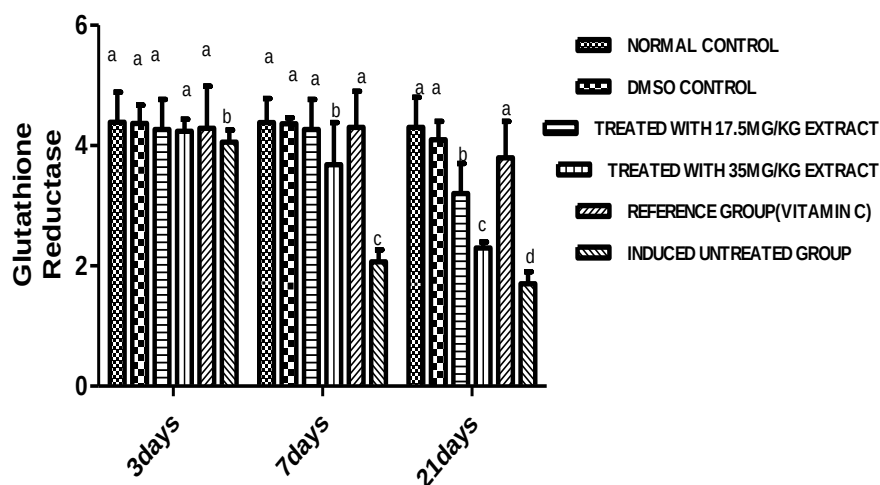


Figure 3: Glutathione reductase activity in rats previously exposed to cement dust and treated with *P. zeylanica* root methanolic extract and vitamin C

Results are Mean $\pm$ SEM of three values. Values with superscript (alphabets) are statistically significant ($P < 0.05$)

There were significant changes ($p < 0.05$) in some of the blood parameters measured. The hematocrit of the normal and DMSO-treated groups were not significantly different ($p < 0.05$). The hematocrit, RBC, WBC, PLT and LYM of the cement-exposed group (untreated) decreased significantly ($p < 0.05$) compared to the normal and DMSO treated groups. This decrease was ameliorated in the group treated with extract at 17.5mg/kg. The extract at 17.5 mg/kg compares to the

reference group significantly. The extract at 35mg/kg also shows significant decrease in hematocrit, RBC, WBC, PLT, MCV, MCHC and LYM for the 3 days, 7 days and 21 days administration.

Table 4: Hematological parameters in cement dust exposed rats during the administration of *Plumbago zeylanica* root extract

Parameter	Grp 1 Normal Control	Grp 2 DMSO Control	Grp 3Exposed & Treated With 7.5mg/kg of Extract	Grp 4 Exposed &Treated With 35mg/kg of Extract	Grp 5 Reference Group (Vitamin C)	Grp 6 Induced Group
HBG (3days) (7days) (21days)	15.7± 0.58 ^a 18.8 ±0.05 ^b 15± 0.06 ^c	15.5± 2.27 ^a 15.0± 0.51 ^a 14.7± 0.29 ^a	15± 1.89 ^a 15.1± 0.45 ^a 13.5 ±0.37 ^d	14.7± 1.21 ^a 13.1± 0.22 ^d 11.5± 0.35 ^e	15.1± 1.72 ^a 18.6± 0.60 ^b 14.2± 0.09 ^{bc}	14± 0.67 ^{bc} 11.1± 0.67 ^e 10± 1.24 ^e
HCT(3days) (7days) (21days)	73.6± 0.67 ^a 55.2± 0.75 ^{bc} 48.8± 0.81 ^c	68.5± 0.61 ^a 52.5± 8.75 ^c 45.7± 0.03 ^e	60.6± 4.63 ^b 52.4± 7.91 ^{bc} 42.3± 1.3 ^f	49.5± 4.21 ^c 39.9± 1.88 ^c 34.9 ±1.23 ^d	65.5± 0.61 ^{bc} 54.27± 3.63 ^{bc} 45.6± 0.38 ^{cd}	48.3± 1.95 ^c 36.8± 4.47 ^d 11.5± 0.35 ^f
MCV(3days) (7days) (21days)	77.6 ±1.47 ^a 74.7± 2.87 ^a 68.1± 0.47 ^b	72.1± 1.14 ^a 60.5± 0.14 ^b 57.8± 2.5 ^c	64.2 ±1.39 ^b 58.3± 0.9 ^c 59.8± 0.07 ^c	60.8± 0.42 ^c 58.3± 0.3 ^c 54.4± 0.57 ^d	65.4± 1.67 ^b 62.8 ±1.92 ^c 59.7± 0.55 ^c	59.4± 0.87 ^d 46.7± 0.6 ^d 48.2± 0.88 ^e
MCHC (3days) (7days) (21days)	40.6± 0.62 ^a 38.2± 1.57 ^a 32.3± 0.53 ^c	37.1± 0.65 ^a 32.1± 1.0 ^c 28.1± 1.8 ^d	35.9± 0.89 ^b 31.5± 0.23 ^c 30± 0.89 ^c	31.2± 0.18 ^c 30.9± 3.1 ^c 27.7± 1.1 ^d	36.2± 1.03 ^b 31.6± 0.84 ^c 31.5± 0.69 ^c	29.2± 0.49 ^d 29±0.26 ^d 25.9± 0.95 ^e
RBC (3 days) (7 days) (21 days)	873.3±10 ^a 869.3±11.4 ^a 798± 1.21 ^b	862± 3.61 ^a 761.±0.68 ^b 577.7±8.64 ^b	767.3±2.14 ^b 725 ±2.14 ^c 681.7 ±18 ^{cd}	742.5±1.54 ^b 633± 7.59 ^d 532.3± 6.1 ^f	785.7 ±2.09 ^b 784.5± 0.08 ^b 777.3± 3.90 ^b	662± 5.52 ^{cd} 597 ±0.5 ^e 542.7± 6.35 ^f
PLT (3days) (7days) (21days)	86.5± 0.58 ^a 80.1± 0.96 ^a 75.3± 0.38 ^b	70.8 ±2.27 ^b 67.5± 1.11 ^{bc} 62.7± 0.04 ^c	70.4± 1.17 ^b 63.5 ±0.54 ^c 58.9± 0.04 ^{cd}	64.5± 2.98 ^{bc} 61.9± 1.5 ^c 53.4± 0.29 ^d	71.8± 1.04 ^b 67.7± 1.1 ^{bc} 58.7± 0.32 ^{cd}	66.3± 1.57 ^{bc} 61.8± 2.45 ^c 53.2± 0.62 ^d
LYM (3days) (7days) (21days)	119.7±2.31 ^a 95.9± 1.06 ^b 91.5± 0.26 ^b	88.3± 0.35 ^{bc} 85.3± 3.92 ^{cd} 73.9± 0.23 ^c	77.5± 3.31 ^c 71.4± 6.55 ^c 72.8± 0.04 ^c	72.2± 8.12 ^c 70.4± 3.98 ^c 39.6± 0.15 ^b	86.6± 0.9 ^{bc} 84.2± 0.3 ^{bc} 73.8± 4.39 ^c	72.9± 1.52 ^c 67.9± 1.18 ^d 35.4± 0.05 ^e
WBC (3days) (7days) (21days)	4.52± 0.02 ^a 2.57± 0.05 ^c 2.49 ±0.05 ^c	2.43± 0.02 ^c 1.69±0.01 ^{ab} 1.60± 0.01 ^e	2.26± 0.02 ^d 2.23± 0.02 ^d 1.36± 0.01 ^e	2.13± 0.01 ^d 1.28± 0.01 ^e 1.27± 0.01 ^e	3.12 ±0.01 ^b 2.41± 0.05 ^c 1.56 ±0.01 ^e	2.13± 0.02 ^d 1.34± 0.01 ^e 0.63± 0.01 ^f

Results are Mean±SEM of three values. Values with superscript (alphabets) are statistically significant (P<0.05)

Discussion

Cement production is a dusty operation resulting in the exposure of factory workers and inhabitants of such area to cement dust. Also, builders using cement are equally at risk of the cement dust. Although protective gears should be worn, reports from third world countries including Nigeria indicate that industries rarely provide adequate protective gears for the workers (Al-Neaimi et al.,2001; Azah et al.,2002) and where it is provided it does not confer total protection against cement dust. The resulting exposure to cement dust has led to impairment of respiration and a prevalence of respiratory symptoms amongst workers (Alakija et al.,1990; Al-Neaimi et al.,2001; Meo et al.,2002).

However, there are reports that contradict this report (Vestbo and Rasmussen,1990; Yang et al.,1993; Fell et al.,2003) which suggest that cement dust exposure may neither increase the morbidity of respiratory diseases (Vestbo and Rasmussen,1990; Yang et al.,1993; Fell et al.,2003) nor be associated with the prevalence of respiratory symptoms among workers (Yang et al.,1993; Fell et al.,2003).

The results of this study however show that cement dust affects antioxidant enzymes, haematological parameters as well as causes lipid peroxidation. There is no significant difference in superoxide dismutase and catalase activity in the normal control Group and DMSO Group for the period of 3 days, 7 days and 21days. The significant decrease observed in superoxide dismutase and catalase activity in the induced Groups (untreated) in the decreasing order of 3 day>7 days>21 days could be due to the fact that exposure to cement dust generates an increase in the production of reactive oxygen species especially superoxide anion and hydrogen peroxide. The hydrogen peroxide and superoxide radical produced are neutralised by catalase and superoxide dismutase respectively; the decrease in the activities of these antioxidant enzymes reveal that exposure to cement dust leads to increased oxidative stress (Ayidin et al.2004).

The significant increase in superoxide dismutase and catalase activity observed in the Group treated with the extract at 17.5 mg/kg body weight of rats may be due to the antioxidant potential of the methanolic extract of *Plumbago zeylanica* root as reported by Zahin et al. (2009) and also as a result of the rebuilding activities of nutrients and phytochemicals present in the plant extract. This result supports the finding of Mindell (1992) that

medicinal plants contain phytochemicals which can purge toxins from the human body. The significant decrease ($P<0.05$) in superoxide dismutase and catalase activity observed in the Group treated with extract at 17.5 mg/kg body weight of rat may be linked to overdose. This suggests that the extract at 17.5 mg/kg body weight of rat is the effective dose. The slight significant increase ($P<0.05$) in superoxide dismutase and catalase activity observed in the reference Group compared to the Group treated with extract at 17.5 mg/kg may be due to the fact that ascorbic acid is the first line of antioxidant defense in the system (Frei et al., 1988; 1989). Vitamin C functions as an important component of cellular defense against oxygen toxicity and lipid peroxidation caused by free radical mechanism (Procter and Reynolds, 1984). Vitamin C provides cellular defense against free radicals. This explains the highest level of antioxidant level in the Group.

The level of reduced glutathione is a measure of the cellular redox status (Chance et al., 1979). Hence alteration in glutathione level may affect the overall redox status of the cell. The significant decrease ($P<0.05$) in glutathione level observed in the induced Groups (untreated) in the decreasing order 3days>7days>21 days may be linked to oxidative stress. Naito (1993) had reported that severe oxidative stress might result in decrease in glutathione. This further confirms that there is an appreciable level of oxidative stress in the Groups exposed to cement dust. The significant increase in glutathione level observed in the Group treated with 17.5 mg/kg of extract shows that the extract at 17.5 mg/kg body weight of rat is ameliorating the glutathione reduction caused by exposure to cement dust. The slight significant decrease ($P<0.05$) in glutathione level observed in the Group treated with 17.5 mg/kg of extract compared to the reference group treated with 17.5 mg/kg of Vitamin C shows that the extract compares to the reference group.

There was no significant difference ($P<0.05$) in lipid peroxidation in the normal control Group and the DMSO control for the 3days, 7 days and 21 days period. The significant increase ($P<0.05$) in malondialdehyde released in the induced (untreated) Group may be as a result of the fact that catalase is usually inactivated by hydrogen peroxide and superoxide radicals. Reduction in residual catalase level confers increased susceptibility on the cell to undergo lipid peroxidation. This increase in lipid peroxidation is in agreement with the study carried out on workers exposed to cement dust. (Orman et.al., 2005). The significant decrease ($P<0.05$) in the level of lipid

peroxidation observed in the Group treated with 17.5 mg/kg of extract suggests the high antioxidant property of the extract. The Group administered with extract at 35mg/kg body weight showed significant increase ($P<0.05$) in the level of lipid peroxidation probably due to overdose of the extract as the effective dose is the 17.5 mg/kg body weight. The slight significant decrease ($P<0.05$) in the level of lipid peroxidation in the Group treated with 17.5 mg/kg of extract compared to the reference Group shows that the extract compares with the reference drug.

The DMSO control Group and the normal Control Group show normal level of hematological parameters for the period of 3 days, 7 days and 21 days. The decrease in the hematocrit (PCV), RBC, WBC and MCV observed in the induced untreated Group maybe as a result of the accumulation of metal ions such as calcium, lead aluminum and chromium e.g. calcium (which is a major component of cement as well as a clotting factor in the blood clotting cascade) in the blood of the animals causing the blood to clot. This clotting is more significant at the 21 day period. Lead has been found to cause decrease RBC and MCV in individuals exposed (Paravath et al., 2001), the decrease in the MCV may also be due to the shrinkage in the size of RBCs (since MCV is a measurement of the average size of RBCs) caused as a result of fat degeneration caused by exposure to cement dust.

The significant increase in haematological parameters observed in the Group treated with 17.5 mg/kg of extract may be due to the activities of antioxidants in the plant extract and the rebuilding activities of the nutrients and phytochemicals in the plant extract.

The histological slides of all the Groups except the DMSO Group and the normal control show a significant increase ($P<0.05$) in lipid peroxidation as shown in the cellular degeneration, foci cellular necrosis, severe cellular hypertrophy and fatty degeneration all of these are as a result of exposure to cement dust. The cement dust produces free radicals in the system, the accumulation of which leads to oxidative stress and ultimately leads to lipid peroxidation. The highest level of lipid peroxidation was observed in the induced Group (untreated) and the Group treated with extract at 35 mg/kg body weight of rat. This lipid peroxidation was not significant in 3 day and 7 day periods in all the groups. The decreased rate of lipid peroxidation observed in the Group treated with 17.5 mg/kg of extract is indicative of the antioxidant potential of methanolic extract of *Plumbago zeylanica* root as

reported by Zahin et al. (2009). A lower level of lipid peroxidation observed at 17.5 mg/kg administration of extract also shows that the extract compares to the reference drug (Vitamin C).

Conclusion

The present study suggests that the profile of enzymatic antioxidant as well as lipid peroxidation is altered by exposure to cement dust and that this effect can be ameliorated by administration of *Plumbago zeylanica* methanolic root extracts in rats.

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