HEAVY METAL ACCUMULATION IN BARK OF AZADIRACHTA INDICA DUE TO VEHICULAR EMISSION

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ABSTRACT

This study is to estimate the level and accumulation of lead in Azadirachta indica (Neem) bark exposed to motor vehicle emissions and noise pollution status within the Campus of Osmania University. Noise pollution studies have been carried out using a digital sound level meter Model SL-4001made in Taiwan. Noise measurements were taken from 7 locations within the campus in three different time intervals of the day i.e, in the morning 9-10 am, midday 12-1 pm and in evening 5-6 pm on working and non-working days. The results indicate that on working days the minimum noise level was recorded as 79.88 dB and maximum of 97.57 dB whereas on non-working days the minimum noise level was recorded as 72.72 dB and maximum of 88.62 dB. The study revealed the fact that noise levels have reached an alarming level due to the vehicular emissions and the main source of heavy metal accumulation in the bark of Azadirachta indica is directly correlated to the vehicular emissions within the campus. It is observed that all the selected locations, the level of noise was found to be above prescribed noise standard level limits of 50 dB for minimum and 40 dB for maximum for silent zone as summarized by the Central Pollution Control Board and Noise Pollution which calls for the urgent need in employing control technologies. Using Atomic Absorption Spectroscopy, concentration of lead was determined in bark samples of Azadirachta indica obtained within the campus. The level of lead in various samples varied between 0.0548 to 0.1082 mg/kg. However, the level of Pb obtained from the samples from various locations from campus was within the permissible limits of WHO/FDA permissible levels of heavy metals in herbal plants.

KEYWORDS: Noise pollution, Vehicular emissions, Heavy metal, Bark, Azadirachta indica, Bio-indicator.

INTRODUCTION

Traffic noise is one of the most immediate and identifiable environmental problem associated with rapid industrialization, urbanization and population growth**.** Traffic noise is considered as one of the important sources of noise pollution that adversely affects human health which may cause feeling of annoyance and irritation, damage to auditory mechanisms, hypertension, deafness and schematic heart disease [1]. Traffic emissions on roads are the main cause of heavy metal accumulation on the surrounding environment including vegetation, which might have an ecological effect on them. Elevated levels of heavy metals in urban and industrialized areas atmosphere are reported in many parts of the world [2].Heavy metal are important group of pollutants. They are non-biodegradable, hence are not readily detoxified and removed by metabolic activities once they are available in the environment. This may subsequently lead to their build-up to toxic levels or bio-accumulation in ecosystem. Determination of chemical composition of plants is one most frequently used methods of monitoring environmental pollution. Various plants have been used as bio-indicators to assess the impact of pollution source on the vicinity which is due to the high metal accumulation in plants. The present study was performed to find out the status of noise level and accumulation of heavy metal (Pb) in the bark of Azadirachta indica due to vehicular emissions within the campus of Osmania University. The result could be used as preliminary baseline data for noise pollution and trace element concentration in the ecosystems for the future assessment and monitoring.

MATERIAL AND METHODS

Study Area

The Osmania University is a public state university located in Hyderabad, India and was founded in 1918 by the Seventh Nizam of Hyderabad state, Nawab Mir Osman Ali Khan for higher learning in India. It is the third oldest in southern India and the first to be established in the erstwhile princely State of Hyderabad. In 2012, the university was placed sixth among the Nation's Premier Universities in Humanities, Sciences and Commerce stream, which bagged the 'University with Potential for Excellence' status. As of today, the university hosts 3,700 international students from more than 80 nations. The sampling locations within the campus are AMS-Andhra Mahila Sabha, LH-Ladies Hostel, AC- Arts College, LC-Law College, BD-Botany Department, EC-Engineering College, P-Press.

Azadirachta Indica

Neem tree (Azadirachta indica) is a tropical evergreen tree native to tropical South East Asia. It is a medicinal plant where pure neem leaves and barks have found various applications producing medicines and natural herbal cosmetics. The barks and leaves contain compounds with proven antiseptic, antiviral, antipyretic and anti-inflammatory [3].

Measure of Noise

Noise level monitoring has been done in heavy flowing traffic condition three times a day i.e 9-10 am., 12-1 pm and 5-6 pm. Noise level was measured at a height of 1.5 m by sound level meter, an instrument which responds to sound in approximately the same way as the human ear and gives reproducible measurement of sound level. Assessment of noise level or sound pressure in dB (A) was carried out using sound level meter (SL-4001) in different locations of study area. The sound frequency from 300 Hz, 60 to 90 dB (A) for medium, 80 to 110 dB (A) for slightly high and 100 to 130 dB(A) for higher intensity of sound.

Bark Sampling Procedure

Bark of Azadirachta indica were sampled at 7 locations within the campus, Osmania University as shown in Fig. 1. Each sample was obtained about 2.0 m above the ground [4] with the aid of pre-washed stainless knife and further washed after each sampling with 10% HNO_3 to avoid cross contamination. The bark sample was wrapped with paper and kept in polythene material and thereafter transported to the laboratory. Each tree was sampled twice, mixed and gross sample obtained.

Digestion of Bark Sample

A 1.0 g of the powdered sample was weighed into a conical flask in triplicate $10cm^3$ of the digestion mixture (a mixture of sulphuric acid, perchloric acid and nitric acid in ration 1:4:40 by volume) was added and left to stand overnight. Thereafter, the flask was heated at $70^{o}c$ for about 40mminutes and then, the heat was increased to $120^{0}c$. The mixture turned black after a while and the digestion was complete when the solution became clear with appearance of white fumes. The digest was diluted with $10cm^3$ of water and boiled for 15 minutes. This was then allowed to cool, transferred into $50cm^3$ volumetric flasks and diluted to the mark with water. The sample solution was then filtered through filter paper into a screw capped polyethylene bottle and stored for heavy metal determination using Alpha 4 atomic absorption spectrophotometer with a digital read out system.

Fig. 1: Bark Samples of Azadirachta Indica.

RESULTS AND DISCUSSION

The present study reveals that all seven sampling locations within the campus of Osmania University are affected by the traffic noise on working and non-working days as these noise levels are higher as shown in Fig. 2 and 3 when compared to the standards of the Central Pollution Control Board, India [5] for the prescribed area category as shown Table 1. Being a educational institution Osmania University fall under the silence zone and the permissible noise limits for this category zone are maximum 50 dB during day time (6 am-9 pm) and maximum 40 dB during night time (9 pm -6 am). The present study suggest that noise level is maximum during the time intervals from 9-10 am, 12-1pm and 5-6 pm at 7 sampling locations on working and non-working days. Osmania University is situated in heavy traffic zone of the city and vehicles' playing through this educational institution is creating high noise levels resulting in a noisy environment within the campus.

Table 1: Ambient Air Quality Standards In Respect of Noise.

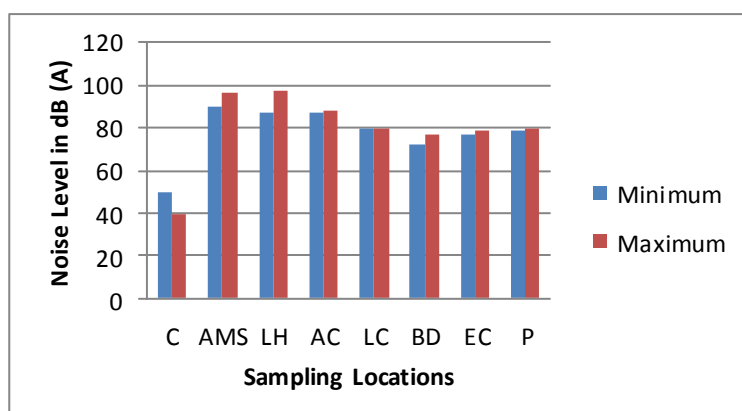| #	Category of area	Day time Intensity (dB) A	Night time Intensity (dB) A
1	Industrial Area	75	70
2	Commercial Area	65	55
3	Residential Area	55	45
4	Silence Zone	50	40

Fig. 2: Comparative Study of Traffic Noise Level on Working Days within the Campus of Osmania University.
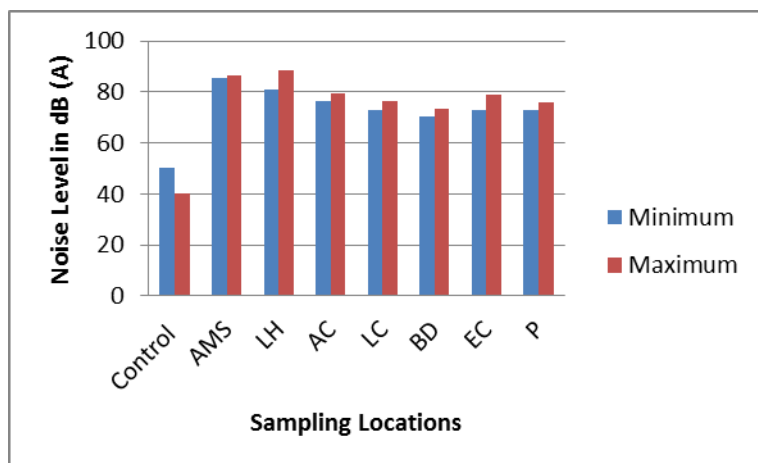
Fig. 3: Comparative Study of Traffic Noise Level on Non-Working Days within Campus of Osmania University.

The results of heavy metal (Pb) accumulated in the bark of Azadirachta indica is given in Fig. 4. The trace element analyzed was found present at various concentrations in all sampling locations. The lead values in the bark of Azadirachta indica are generally low when compared to the standards of WHO/FDA [6]. But the presence of lead in the samples might be probably due to the high level of traffic emissions in the study area which is an indication to the environment pollution.
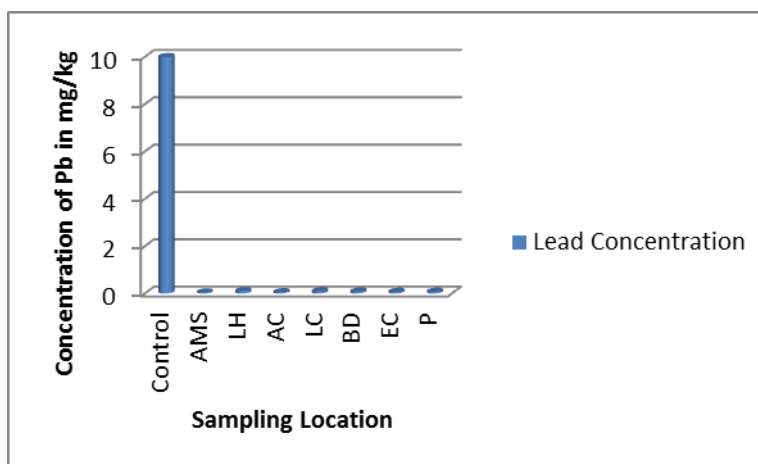

Fig. 4: Concentration of Heavy Metal (Pb) in Bark of Azadirachta indica.

The concentration of trace metal such as Pb was found in bark of Azadirachta indica in campus of Osmania University with high traffic density which also correlates with the traffic volume, this observation is similar to that of [7]. The tree used in the study is of medicinal value and economic importance. Hence, the accumulation of this metal over time in the body system is of health concern, as trace metals found its route to man directly or indirectly [8]. This study further demonstrates Azadirachta indica tree bark as a good bio-indicator

widespread and easily adaptable are other factors that favor its choice as indicator [9]. Polytrichum junipercum found on the bark of Azadirachta indica to assess heavy metal pollution and confirmed that the concentrations of pollutants in the tree bark correlate with those of the environment.

CONCLUSION

The present study reveals that seven sampling locations within the campus of Osmania University are affected by the traffic noise as these noise levels are higher compared to the standards of the CPCB for the prescribed area category. There is an urgent need to stop the vehicle entry into the campus and an alternate bypass road with a better management of transport system should be used to stop noise level and vehicle emission within the campus. The vehicle emissions for the longer exposure within the campus were correlated with heavy metal accumulation in the bark of Azadirachta indica which indicated the presence of lead analyzed in all sampling locations. This might be attributed to the geological status of the area under investigation and the ability of plants and their specific parts to accumulate metals and as well the vehicular emissions in the campus. The presence of lead in herbal plants in this study further confirms the increased danger of environmental pollution within the campus due to vehicular emission.

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