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Influence of primary air pollutants on local biota of Trichy, India

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Abstract

Air pollution is one of the serious problems faced by the people globally, especially in urban areas of developing countries like India. All these in turn lead to an increase in the air pollution levels and have adverse effects on the health of people and plants. In any well planned urban set up, industrial pollution takes a back seat and vehicular emissions take precedence as the major cause of urban air pollution. The unplanned growth of cities in India has led to the problems of increasing slums, vehicular traffic and air pollution. Automobile exhaust, which also consists of all major air pollutants is a significant source of air pollution in the urban context. The present paper deals with the study on concentration of major air pollutants from vehicles and their influence on local biota like plants and human beings in Tiruchirappalli city besides this the impact on plant species and human health has been undertaken.

Keywords: *Ambient air quality, Health disorders, Biota, Trichy*

Introduction

Air pollution caused by automobiles has been described as the "disease of wealth". Around the world, five major types of materials are released directly into the atmosphere in their unmodified forms and in sufficient quantities to pose a health risk. They are carbon monoxide, hydrocarbons, particulates, sulfur dioxide and nitrogen compounds. This group of pollutants is known as primary air pollutants. These materials may interact with one another in the presence of an energy source to form new secondary air pollutants such as ozone and other very reactive materials. Secondary air pollutants also form from reactions with natural chemicals in the atmosphere. Human health is very closely linked to environmental quality, as the Etiology of most of the human diseases being related to the status of the living environment of man. According to statistics, 25% of all preventable illnesses are caused by detrimental environmental factors. In developing countries the air quality crisis in cities often attributes in large measures (40–80%) to vehicular emission. The improved performance of technology is presently insufficient to counteract the growth of vehicles (Anon, 1997a, 1997b).

The Trichy city (10.5°N, 78.43°E, 78.8 MSL), situated at the bank of the river Cauvery and is the fourth largest city in Tamil Nadu. It spread over an area of 146.90 sq. km with total population of above 8, 36,000.Trichy is very rapidly growing in terms of its population and number of vehicles. The 4 major highways NH-45, NH-67, NH-210 and NH-277 passes through the city. The heavy traffic on these highways has been significantly contributed to air pollution in the city

Materials and Method

Ambient air quality was monitored for major air pollutants *viz* Suspended Particulate Matter (SPM), Sulphur dioxide (SO_2) and Oxides of Nitrogen (NO_X). High volume sampler (Envirotech APM-430) is used for sampling. SO_2 and NO_X were absorbed in Sodium tetrachloromercurate and Sodium hydroxide. Analysis of this solution was done according to West and Gaeke (1956). The monitoring was done for 24 hours. This research work was carried out from July 2008 to June 2009. Eight sampling stations were selected to represent different traffic

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volumes and activities which includes Central Bus Stand, Chattram bus stand, Puthur, Palakarai, Srirangam, Main guard gate, TVS toll gate and Old Paalpanne Circle.

Leaf samples were collected from 15 different plants growing commonly in traffic areas of Tiruchirappalli city and their Air pollution tolerance index (APTI) was determined the Polythene bags were used for storing leaf samples during transportation. The leaf samples were refrigerated at about 20^0 C. The samples were estimated for Leaf-extract pH, relative moisture content, total chlorophyll and ascorbic acid following the standard methods of APHA (1977) and Arnon (1949).

APTI was calculated using the formula:

$$APTI = \frac{[A\ (T + P) + R]}{10}$$

Where,

A = ascorbic acid in mg/g
T = total chlorophyll in mg/g
P = pH of leaf sample
R = relative water content in mg/g.

Data related to adverse effects of vehicular pollution on human health in eight different locations of Tiruchirappalli has been collected by the 'Questionnaire method', covering many individuals. A questionnaire was prepared and survey was conducted particularly in case of suspected allergic population by inquiring the recurrence of the type of allergic symptoms and other respiratory diseases. The occasions of this onset was recorded with each individual to assess the allergic status. The secondary data were collected from various health centers, hospitals and clinics which belong to the area under study.

Results and Discussion

Table-1 shows average concentrations of SPM, SO_2 and NO_X at each sampling station. The highest concentration of NO_X, SO_2 is recorded at Palakarai, while the highest SPM concentration was recorded at Chattram bus stand. SPM concentrations ranged from 312.46 to 1401.41µg/m^3. SO_2 concentrations ranged from 13.03 to 30.19 µg/ m^3. NOx concentrations ranged from 120.31 to 171.21µg/ m^3.

The air pollution tolerance index (APTI) value of 15 different plants growing commonly in traffic area of the city is given in Table 2. In the present study the maximum APTI is observed in *Azadirachta indica* (12.95) and minimum in *Enterolobium saman* (7.12) (Table 2). Agarwal and Bhatnagar (1991) studied APTI of some selected plants and described *Mangifera indica* as reliable bioaccumlator plant. Agarwal and Agarwal (1988) also reported high sensitivity of *Mangifera indica*, *Azadirachta indica*, *Psidium guajava*, *Bougainvillea glabra*, *Lagerstroemia indica*, *Morinda tinctoria*, *Hibiscus rosasinensis*, *Ixora coccinea*, *Polyalthia longifolia*, *Achras sapota* and *Cassia fistula* and reported high APTI values and considered them as tolerant plant.

Table 1: Average concentrations of SPM, SO_2, and NO_X (µg/m^3) at different sampling stations

Sampling Station	SPM	SO_2	NO_x
Central Bus Stand	1121.99	21.72	153.17
Chattram Bus Stand	1401.41	19.26	157.55
Puthur	617.32	13.03	156.92
Palakarai	890.03	30.19	171.21
Srirangam	353.17	14.88	132.21
Main Guard Gate	929.27	19.28	164.19
TVS Toll Gate	312.46	17.70	161.13
Old Paalpanne Circle	900.17	18.29	120.31

Total exposure to an individual to a specific pollutant is determined by the concentration of contaminant and the duration of its exposure. Exposure to indoor and outdoor air quality is different because they always change with time and diurnal pattern. Exposure to SPM is also an equally serious risk to health. SPM includes all air-borne particles in the size range of 0.5 μ to 100 μ. The actual health damage caused by dust particles depends upon its nature and composition. The effects attributed to mild eye irritation mortality. The data generated from the survey were analysed to assess the percentage of allergic population and the suspected allergy causing agents. The results are shown in Table 3.The assessment of respiratory disorders (RDs) was obtained from thequestionnaire survey from the doctors. On the basis of the survey of the SPM-related RDs each disease was recorded for indexing the imprint class I to IV (Table 4). The highest imprint score depicts the maximum severity of RDs.

Table 2: APTI of some selected plant species

Name of the plant Species	pH	% of Relative moisture content	Total Chlorophyll mg/g	Ascorbic acid mg/g	APTI
Achras sapota	4.3	88.22	0.97	1.71	9.72
Azadirachta indica	5.9	90.77	0.42	6.14	12.95
Bauhinia purpurea	4.1	87.39	0.40	0.70	9.05
Bougainvillea glabra	5.5	90.56	1.56	2.80	11.03
Cassia fistula	4.2	80.01	0.30	3.23	9.45
Citrus aurantifolia	3.9	79.00	0.24	1.89	8.68
Enterolobium saman	4.9	65.31	0.69	1.07	7.12
Hibiscus rosasinensis	4.2	91.49	0.71	2.40	10.32
Lagerstroemia indica	4.2	84.94	1.60	3.51	10.52
Mangifera indica	6.9	81.43	0.50	5.10	11.91
Morinda tinctoria	4.7	90.93	0.26	2.41	10.28
Polyalthia longifolia	5.2	90.99	0.18	1.43	9.86
Pongamia glabra	4.4	84.30	0.38	0.93	8.87
Psidium guajava	6.6	81.97	0.21	6.64	12.71

Table 3: Estimation of Allergic Symptoms

Complaint	Total no. cases	Condition	No. of person	Percent of incidence
Neck block	20	Allergic	17	85
		Non- Allergic	3	15
Sneezing	35	Allergic	30	86
		Non- Allergic	5	14
Cough	60	Allergic	50	83
		Non- Allergic	10	17
Hyperacidity	29	Allergic	18	62
		Non- Allergic	11	38

Table 4: Imprint classification of respiratory diseases

Imprint score	Symptoms
0.0	No RD: healthy, free from any respiratory disease
2.5	Mild RD: suffering from only upper track respiratory infections (UTRI)
5.0	Moderate RD: suffering from UTRI as well as lowest track respiratory infections
10.0	Severe RD: Suffering from bronchitis, asthma, allergic thintis, fibrosis, asbestosis, pneumoconiosis and non-malignant RDs

Conclusion

Suspended Particulate Matter (SPM) is the main pollutant within the Tiruchirappalli city. In all eight sampling sites, the concentration of SO_2 is well within the CPCB limits. The reason being the growing number of automobiles and poorly and congested road with heavy traffic. This problem

can be overcome by adapting advance ecofriendly transport systems, usage biofuels and widening of roads. The plants with low APTI value like *Bauhinia*, *Pongamia*, *Citrus* and *Enterolobium* were categorize as sensitive and plants with high APTI value like *Azadirachta*, *Psidium*, *Mangifera*, *Bougainvillea*, *Largerstromia*, *Morinda*, *Hibiscus*, *Ixora*, *Polyalthia*, *Achras* and *Cassia* as tolerant. The study reveals that urban air pollutants have adverse effects on human health. In Tiruchirappalli city many individuals residing near by traffic intersections are suffering from respiratory diseases. Proper control measures may tackle this unhealthy problem of urban pollution.

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