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Chemical Estimation of Air Pollutants and Its Impact on the Flavonoid Content of *Adhatoda vasica, ocimum sanctum; and Aloe Vera*

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Abstract

The present investigation was carried out to establish a correlation environmental pollution especially the SO_2, Nox, RSPM, SPM and O_3 pollution with plant chemistry. In this present study chemically estimate SO_2, No_x, RSPM, SPMand O_3 at SLP govt. PG College, Maharaj bada and Deendayal Nagar. Samples of three medicinal plants *Adhatoda vasica, ocimum sanctum* and *aloe Vera* were analyzed for their phytochemical composition, flavonoid contents the result revealed the presence of bioactive constituents Flavonoid. The result of this study show that the Flavonoid content in *Adhatoda vasica* and *aloe vera* plant decreases with increases pollutant and *ocimum sanctum* show positive correlation with pollutants.

Keywords: ozone(0_3), sulphur dioxide(SO_2), oxides of nitrogen (No_x), respirable suspended particulate matter(RSPM), suspended particulate matter (SPM), flavonoid content, adhatoda vasica, ocimum sanctum and Aloe Vera.

Introduction

Environmental pollution and its impact on plant have well recognized. The role of air pollutants causing injury to plants either by direct toxic effect or modifying the host physiology[1]. The environment defined as to include water, air and land, the interrelationship which exists among and between water, air and land, and human being, plant, other living creatures, micro-organisms[2]. Environment is continuously polluted due to increasing the concentration of NO_x, SO_2, SPM, and O_3. Pollution means the presence of undesirable substances in any segment of environment, primary due to human activity discharging by products, waste product or harmful secondary products, which are harmful to man, vegetation or other organism. Ozone in the lower atmosphere is a highly reactive secondary pollutant photo chemically formed in the presence of primary pollutants like NO_x, SO_2, Suspended particulate matter (SPMandPM), HC and CO etc, which are (NO_x, SO_2, O_3 and SPM) the major constituents of automobile exhaust.

Atmosphere plays a significant role in global processes supporting life on earth. It serves as an efficient heat reservoir. Troposphere is a zone closest to earth. It is an important zone for living world. Stratosphere is next zone to the troposphere. SO_2, NO_x, SPM, and Ozone are present in the troposphere and stratosphere[3]. While ozone in the presence of stratosphere protects the entire biosphere from the lethal ultraviolet radiation by absorption it[4] in the troposphere it acts as a toxic green house gas by an absorbing terrestrial radiation[5] and contribute to the global warming. Highly reactive Ozone binds to plasma membrane, alters metabolism and inhibited stomatal photosynthesis. Ozone reacts with O_2 and produces reactive oxygen species, including hydrogen peroxide (H_2O_2), Super oxide ($O^{2}\bar{\cdot}$), Singlet oxygen, and the hydroxyl radical. These denature proteins and nuclic acid, and cause lipid per oxidation, which break down lipids in membrane.

Material and Method

Plant material: Samples of *Adhatoda vasica, Ocimum Sanctum* and *Aloe Vera* were collected from SLP PG college morar, Deen Dayal Nagar and Maharaj bada sampling sites.

Test for flavonoids: A portion of crude powder was heated with 10 ml of ethyl acetate over a steam bath for 30 min. The mixture was filtered and 4 ml of the filtrate was shaken with 1 ml of dilute ammonia solution and observed a yellow coloration[6].

Estimation of Pollutants: In this study Sulphur dioxide, Nitrogen dioxide, Suspended particulate matter, Respirable suspended particulate matter and surface ozone concentration along with air temperature, relative humidity, wind speed, wind direction and traffic density has been monitored in Gwalior at three sites. SO_2 and NOx estimation has been done spectrophotometrically by Systronic 108 UV visible sppectrophotometer. West-Gaeke[6] and Jacob- Hocheiser(1958)[7] method has been used for the determination of SO_2 and NOx respectively.GF/A whatman's filter paper No. 1 used to collect Suspended particulate matter. Ozone collected by bubbling through borosilicate glass impingers containing 1% KI solution (pH 7.0). Ozone estimation was done colorimetrically by the method of Byers Saltzman[8] with the modification suggested by Boyd et al.,[9]. Ozone concentrations have been expressed as ppbv. It's determined colorimetrically at 352nm.

Extraction of flavonoids: Accurate 10 g of raw plant material was extracted with 25 ml of 95% methanol under 200 rpm shaking for 24 hour. After filtration, the filtrate was adjusted to

25 ml with 80% methanol and stored in an amber bottle at 4°C. The flavonoids constituents extracted are quantified spectrophotometric method.

Quantification of total flavonoids content in plants by Spectroscopic method: Total flavonoids content was determined as per the method described by Chang et.al. (2002)[10]. each plant extracts (0.5 ml of 1:10g/l) of each plant in methanol was separated mixed with 1.5 ml of methanol,0.1 ml of 10% aluminium chloride,0.1 M potassium acetate and 2.8 ml of distilled water. After keeping the mixture at the room temperature for 30 minutes, the absorbance of the reaction mixture was measured at 415nm with a double beam UV/Visible Spectrophotometer. The calibration curve was prepared by using quercetin and rutin as a standard solution.

Results and Discussion

The average data of ambient air quality with lower and upper limits are given in table 1 and results are shown figure 4.a to 4.c. In this present study the lower and upper limits of air pollutants at different locations were observed for RSPM (10.2µg/m^3- 825µg/m^3), SPM (26µg/m^3- 956µg/m^3), SO_2 (1.9µg/m^3-33 µg/m^3), NO_2 (3.2µg/m^3- 46µg/m^3) and (0 ppbv – 22 ppbv). The level of RSPM was maximum (825 µg/m^3) at Maharaj bada location during August, which is more than four times of CPCB level (200 µg/m^3) prescribed for residential area. The lowest level of RSPM was recorded at SLP in August (10.2µg/m^3). Similarly, highest (956 µg/m^3) level of SPM was recorded at Deen Dayal Nagar during August and lower for SLP 26 µg/m^3 in August month. The NO_2 level at Maharaj bada was highest (46 µg/m^3) in April month, while the lowest (3.2µg/m^3) level was recorded in August at SLP College. The level of SO_2 was found to be lower than NO_2 at all study locations through out the year. SO_2 was highest (33µg/m^3) for Maharaj bada during November while lowest (1.9µg/m^3) at SLP during August Month. Ozone level was highest (22µg/m^3) in April at Maharaj bada, while lowest (0µg/m^3) for SLP college in January and August months.

From the average data of ambient air quality concluded that Maharaj bada sampling site is more polluted due to SO_2, NO_2 and O_3 at all the seasons and SLP college site is less polluted. Deen Dayal Nagar is highly polluted due to total Suspended particulate matter.

Table-1
Ambient air pollutants at different location during different representative months from 2008-2011

Sampling sites	January		April		August		November	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
SO_2 (µg/m^3)								
a. Maharaj bada	4.5-20.41	12.50	5 – 32.7	12.12	4.5– 25.25	11.462	5 - 33	12.578
b. Deendayal Nager	4 – 16.6	9.297	4 – 17	10.357	4.0 -17	10.12	5 - 25	10.918
c. SLP College	2.1-11.7	5.471	3– 14.78	7.9245	1.9– 14.25	7.009	3- 12.12	6.2445
NOx(µg/m^3)								
a. Maharaj bada	5.9– 35.7	17.4236	7.1-46	19.050	6.8-32.7	18.211	7.1 -39	18.574
b. Deendayal Nager	8.3– 35.7	18.163	7.9 -36.6	20.983	7.1 -37	18.875	9.5-35.7	19.025
c. SLP College	4.0– 18.46	9.078	5 - 20.34	11.6345	3.2-20.1	10.518	5.2-18.79	11.5035
O_3 (ppbv)								
a. Maharaj bada	1.03-8.02	7.84	4.01 -22	19.86	0 -6.95	6.21	1.67 -10	9.3
b. Deendayal Nager	0.64 -8.0	6.77	2.96 -18	16.63	0 -6.28	4.99	1.02-12.3	9.576
c. SLP College	0 -2.32	1.39	0.32 -5.95	5.41	0 -1.6	0.84	0.84-4.91	3.07
RSPM (µg/m^3)								
a. Maharaj bada	48 -664	233.86	59 -669	237.643	21 -825	224.38	53 -597	186.689
b. Deendayal Nager	62 -602	265.64	73 -605	293.714	12 -695	279.52	42 -624	270.172
c. SLP College	52 - 380	207.2875	43-395.72	206.1617	10.2-296.3	134.02	24-276.3	161.776
SPM (µg/m^3)								
a. Maharaj bada	127 -754	352.65	126 -736	341.671	63 -824	294.72	120 -809	306.47
b. Deendayal Nager	123 -782	371.71	130 -750	411.142	43 -956	376.67	98 -680	394.716
c. SLP College	96 - 402	288.6333	114-408.23	292.5233	26-280.3	177.4192	89.3-378.2	230.766

Table-2
Total flavonoid contents of *Aloe vera, ocimum sanctum* and *Adhatoda vasica* at three sampling sites during different seasons

No.	Plant	Seasons	Sampling sites					
			MRB 2010	DDN 2010	SLP 2010	MRB 2011	DDN 2011	SLP 2011
1	*Aloe vera* (mg)	January	2.02	2.34	3.49	1.96	1.96	2.69
		April	0.74	1.01	1.67	0.48	0.98	1.42
		August	3.01	2.49	4.94	2.63	2.01	3.16
		November	1.34	1.48	2.08	1.26	1.32	1.94
2	*ocimum sanctum* (µg/g)	January	262.15	255.3	148.4	283.62	263.70	182.9
		April	210.3	186.4	99.63	235.4	255.31	101.46
		August	85.3	56.2	29.3	119.3	156.34	55.32
		November	282.3	269.3	135.0	262.8	226.2	120.01
3	*Adhatoda vasica* (mg/g)	January	38.49	36.58	46.01	32.41	22.04	40.58
		April	20.14	24.23	28.39	20.01	22.49	26.31
		August	46.32	40.32	62.33	40.04	28.60	60.66
		November	30.05	25.58	38.54	28.49	20.02	34.32

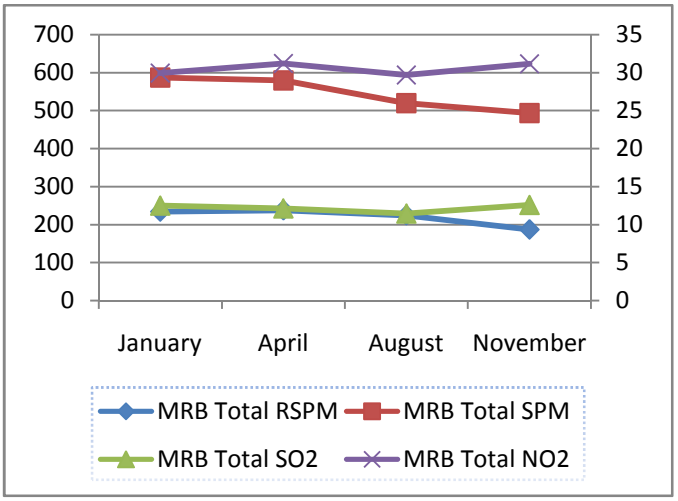

Figure-1
Total RSPM/SPM/SO_2/NO_2 at MRB sampling site in different months

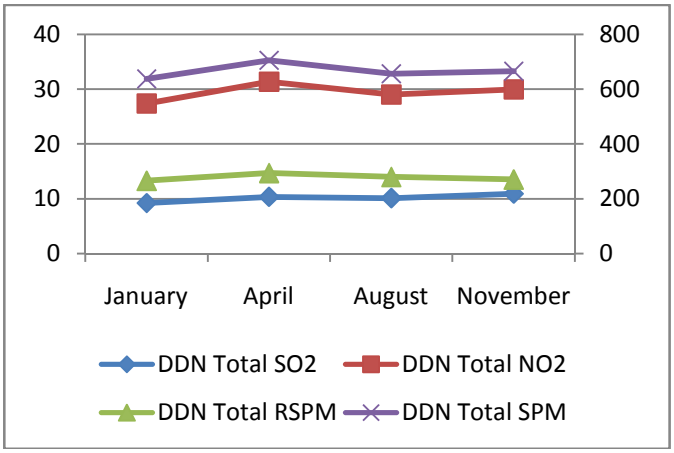

Figure-2
Total RSPM/SPM/SO_2/NO_2 at DDN Sampling site in different months

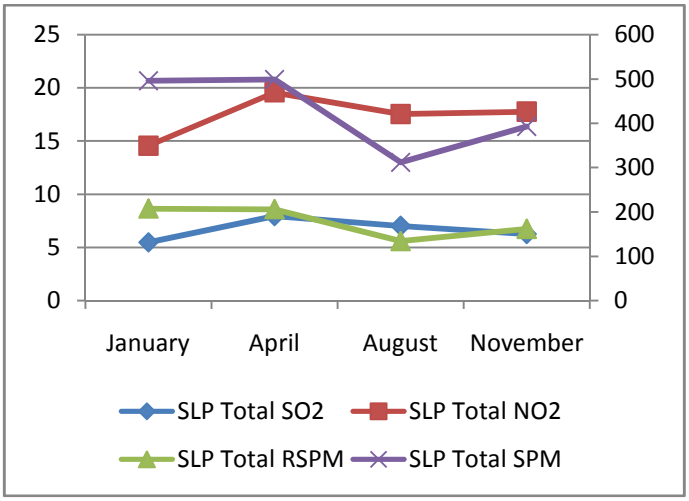

Figure-3
Variation of RSPM/SPM/SO_2/NO_2 at SLP College in different months

Total flavonoids content of *Adhatoda vasica, Ocimum sanctum* and *Aloevera* in differen representative months has been shown in table 2. Total flavonoids contents from *Adhatoda vasica, Ocimum sanctum* and *Aloevera* have been determine by aluminium chloride colorimetric method described by change et al. Quercetin was used to perform the calibration curve (standard solution) in methanol for *adhatoda vasica*. The absorbance of the reaction mixture was measured at 415nm. The total flavonoid contain for *adhatoda vasica* was expressed as quercetin equivalent using the standard curve equation and result were expressed as mg/g. The flavonoid contain were found between 20.01 to 62.33mg/g and it was found maximum 62.33mg/g at SLP in August month in 2010.

For *ocimum sanctum* rutin was used to perform the calibration curve in methanol. The absorbance of the reaction mixture was measured at 415 nm. Total flavonoid contain for *ocimum*

sanctum was expressed as rutin equivalent and result were expressed as µg/g. The flavonoid content was found between 29.3 to 283.62µg/g and was found maximum 283.62 at Maharaj bada sampling sites. For *Aloevera* plant rutin was used to perform the calibration curve in methanol. The absorbance of reaction mixture was measured at 415nm, and result was expressed as rutin equivalent in mg. The total flavonoid contents were found between 4.94 to 0.48mg and it was found maximum at SLP College.

Conclusion

From the result it conclude that the vehicular pollution resulted in significant increase in the total flavonoid content in *ocimum sanctum* plant (table-19) .for *ocimum sanctum* plant, Maharaj bada sampling site recorded highest value of total flavonoid during April season and lowest value of during all seasons at SLP college. These findings are in agreement with the finding of A. Qayoom Mir et al[11] who has reported increase in total flavonoid and phenolics in *catharanthus roseus* L. and *ocimum sanctum* L. as bio markers of urban auto pollution. This finding can also be attributed to the finding of Nikolova and Ivancheva[12], who have reported increase total flavonoids in *Artemisia vulgaris L; and veronicachamaedrys* L; in relation to air pollution stress.But opposite results were found for *Aloevera* and *adhatoda vasica* plant. In both plant the total flavonoid content decreases with increasing pollution level (i.e. NO_2, SO_2, SPM, RSPM and Ozone). In both plants, SLP sampling sites recorded the highest value of total flavonoid content during all seasons, which decreased significantly along the site attaining minimum value at Maharaj bada sampling sites and total flavonoid content continuously to decreases from 2010 to 2011. These findings are in contrary to the observation of A. Qayoom Mir et al[11]. In the present investigation it was observed that the total chlorophyll content in *adhatoda vasica* and *Aloe vera* were found decreases in more polluted habitats and in *ocimum sanctum* total flavonoids increases in polluted habitats.

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