Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; SP4: 08-10

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(Special Issue- 4)
International Conference on Food Security and Sustainable Agriculture
(Thailand on 21-24 December, 2018)

Evaluation of gaseous pollutants level prevailing in the ambient atmosphere around Barauni Oil Refinery

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Abstract
Air pollution occurs when harmful or excessive quantities of substances including gases, particulate & biological molecules are introduced into Earth's atmosphere. It may cause diseases, allergies and also death of humans, it may cause harm to other living organism such as animals & food crops. Human activity & natural processes can both generate air pollution. Air pollution is expected to have a pronounced effect on vegetation near to industry. The present study concerns the concentration & distribution of pollution emissions from Barauni Oil Refinery & their effects on the surrounding vegetation & ecosystems. The major pollutants liberated from refining of crude petroleum at Barauni Oil Refinery or SO_2, NO_2 & suspended particulate matter. These pollutants have proven hazardous effect on the surrounding environment as the crosses the threshold value. The ambient air around Oil refinery possesses heavy quantity of pollutants which hinder all growth activity of plants growing in viscinity of oil refinery.

Keywords: Pollutants, SO_2, NO_2, SPM, Threshold value, concentration

Introduction
Air pollution receives one of the prime concern in India, primarily due to rapid economic growth, industrialization and urbanization with associated increase in energy demands. Lacks of implementation of environmental regulations are contributing to the bad air quality of the Indian cities. Air pollutants produced in any air shed are not completely confined, but at time trepassing all the geographical boundaries, hence do not remain only a problem of urban centres, but spread and affect remote rural areas supporting large productive agricultural land. Refining of petroleum products in one of the important sources of atmospheric pollution, Barauni Refinery has a capacity of 6 million tonnes per annum. Therefore, it is expected to discharge daily a heavy load of 25-30 tonnes of SO_2, 100 tonnes of NO_2 and other harmful elements (Khoshoo and Ahmad, 1981) [6]. It was therefore, endeavored to find out how much pollutants particularly SO_2, NOx and suspended particulate matter, this contributing to its ambient atmosphere inspite of its tall claim of keeping the pollution under control. The combustion of sulphurious Fossil Fuels i.e coal and petroleum and smelting of sulphur containing metal ores emit large amount of sulphur dioxide in the atmosphere. The atmosphere polluted by SO_2 is toxic to mankind, destructive to vegetation and construction materials (Ismail *et al.*; 1978) [5]. The concentration of the pollutant is generally maximum during autum winter (Bertolaccini and Gucci, 1985) [2]. The other important gaseous air pollutant is nitrogen dioxide.
It occur usually in combination with sulphur dioxide (Pande and Mansfield, 1985 a & b) [7]. NO_2 is the most important component in relation to plant growth (Fowler and Cape, 1982). Nitrogen Oxides of themselves are not phylotoxic. However in combination with sulphur dioxide, it manifests synergistic effects (Tingey *et al.*, 1971).
As the gas reaches the wax surface of parenchyma, it forms nitrous and nitric acids which injure the other tissue. The Suspended particulate matter (S.P.M) is conglomerate of chemically heterogenous substances. The SPM values attain maximum limit during summer (Sharma *et al.*; 1983) [8]. The particulate pollutants disturb photosynthesis by reducing the quantum of light and raising the surface temperature of leaves (Rao, 1972; Kumawat and

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Dubey, 1988). The adverse effect of Industrial pollutants may also cause plant injury (Vora and Bhatnagar, 1987) [10] Exposures of high SO2 concentration in plant for short duration result in acute injury and that to low SO_2 concentration for long duration result in chronic injury. Sulphur content is directly related to atmosphere SO_2 concentration (Farral *et al.*; 1977). It is known that some SO_2 taken up by the plants may be converted to H_2S and returned to the atmosphere and some may leach out of the leaves after conversion to sulphate (Decormis, 1969) [4] while the accumulated sulphur may cause the injury to the plants.

Materials and Method

Five study sites were selected nearby Barauni Oil Refinery (i) Gomanpur (ii) Deona (iii) Mahna (iv) Saboura (v) Simaria (Reference Site)

Monitoring of the pollutants

The samples of the pollutants, SO2, NO2 and suspended particulate matter (S.P.M) were collected with the help of 'High volume air Sampler', 4 ft above the ground level near the crop Fields between 10 a.m to 6 p.m at monthly interval.

(i) Sulphur dioxide

The concentration of sulphurdioxide in ambient air was determined by the method of West and Gaeke (1956). Ambient air was bubbled through O.1M sodium tetra chloromercurate in glass impinge at the rate of 1 litre /minute for six hours. The volume of the absorbing medium was readjusted to 15 ml mark in the impinge. The Solution of sulphuric acid (0.6%), formaldehyde (0.2%) and pararosaniline hydrochloride (0.5%) were added to samples and after 15 minutes the absorbance was read at 560nm.

Sulphur dioxide content in the sample was determined from the calibration curve of sodium metabisulphate.

The concentration of SO_2 was finally determined with the help of the following formula

$$\text{SO2 concentration } (\text{ug/M}^3) = \frac{ugSo2}{volume\ of\ air\ sampler\ (lit)} \times 10^3$$

Nitrogen dioxide (NO_2)

For the determination of concentration of nitrogen dioxide, the method of Jacobs and Hochheiser (1958) was employed. Nitrogen dioxide was collected by bubbling air through a sodium hydroxide - Sodium arsenite (0.4/0.1gm, W/W/100 ml) solution in glass impingers for 6 hrs.

(ii) Suspended particulate matter (S.P.M)

For the determination of suspended particulate matter, the filtration method of Giever (1972) was employed during the High Volume Air Sampler. The Samples were collected continuously for 6 hrs. Whitdman fitter paper (GF /A) grade, oven -dried at 105 ^oC for one hour was weighed (W_1) Filter paper was fixed on the filter holder of the sampler with its rough side upward.

Results and Discussion

The problems of atmospheric pollution are rapidly growing in most parts of the world on account of high demand for energy. Within the complex of air pollution some gaseous components are very phytotoxic monitoring of the gaseous pollutants of five study sets around Barauni refinery reveals that SO_2 concentration averaged 28.26 to 37.45 ug/m^3 at Saboura, Dcona, Mahna and Gomanpur as against only 9.01 ug/m^3 at Simaria on seasonal basis (Table-1) NO_2 concentration varied from 32.32 to 39.64 ug/m^3 at polluted sites as compared to only 8.73ug/m^3 reference site (Table-II). These variations were significant between sites for both gaseous pollutants. Higher value of gaseous pollutants at polluted sites can be attributed to their proximity to the refinery chimney. Where upon the gases can easily teach in at significantly high concentration. Simaria (Reference site) being 10km away from the sources of pollution. Remains largely free from these gases because gases are greatly diluted by the time they reach there. Even their seasonal concentrations were elevated and distinctly exceeded the standards at polluted site in case of SO_2 and at all sites in case of NO_2. The present levels of SO_2 and Nox at these sites assume greater importance in the light of the fact that these standard have been made on report of single pollutant (kress *et al*., 1982)

Whereas No_2 and So_2 in combination are for more toxic even at lower concentration than aceets realized (Agrawal *et al*., 1983) [1]. Low levels of these pollutants in ambient atmosphere around Barauni refinery, with respect to their standards, can be partially attributed to diurnal cycle. For the monitoring of the pollutants was done between 9 a.m and 5 p.m which is not peak inversion period on account of high temperature at the time of the day and that helped greater dispersion of the gaseous pollutants to the upper strata of the atmosphere.

Air pollution due to particulates mostly arises from release of smoke, ash and other matters from chimney, factories etc (Bhatnagar, 1983) [3]. At all the study sites including the reference one, SPM concentration was found to be considerably high during both the years but there was no significant difference between the sites. In addition to discharge from refinery, chimney, sufficient part of SPM concentration might have been contributed by the semiarid climate of the area where even slow wind carries away enough of dust into the atmosphere. At all the study site SPM level was mush higher in November than in subsequent month of December and January. From the above investigation, it is clear that higher levels of pollutants present near Barauni Oil Refinery causes injurious effects on the surrounding vegetation and eco system.

Table I: Concentration of SO_2 (ug/m^3) in ambient atmosphere at the study sites during the year (2012-13 & 2013-14)

Months	years	Study sites				
		Simaria	Saboura	Deona	Mahna	Gomanpur
November	2012	10.17	28.95	20.43	24.31	29.37
	2013	7.45	30.10	34.39	36.14	32.06
Average		8.81	29.52	27.41	30.22	30.71
December	2012	9.38	26.09	53.08	29.99	26.28
	2013	9.70	28.80	30.46	22.87	42.90
Average		9.54	27.44	41.77	26.43	34.59
January	2013	9.51	38.32	36.50	25.37	26.35

	2014	7.90	42.51	49.87	30.89	32.80
Average		8.70	40.41	43.18	28.13	29.57
Seasonal average		9.01	32.45	37.75	28.29	31.62
	S.D	0.37	5.68	7.12	1.55	2.14
	S.E	0.21	3.28	4.11	0.89	1.24
Correlation with atmospheric factors						
Temp.		-0.29	-0.70	-0.84	0.00	-0.54
R.H.		-0.70	-0.60	-0.31	0.91	-1.00
Wind Velocity		0.99	-0.62	0.42	-0.83	0.97
Analysis of variance						
Sources of variation		df	S.S	M.S	F.value	F.table
					Calculated value at 5%	
Between months		2	54.65	27.32	1.01	4.46
Between sites		4	1447.52	361.88	13.39	3.84
Error		8	216.15	27.01	-	-
Total		14	1718.33	-	-	-

Table II: Concentration of NO2 (ug/m^3) in ambient atmosphere at the study sites during the year (2012-13 & 2013-14)

Months	**years**	**Study sites**				
		Simaria	**Saboura**	**Deona**	**Mahna**	**Gomanpur**
November	2012	9.92	30.46	24.55	57.47	57.86
	2013	6.03	23.95	22.10	26.74	20.46
Average		7.97	27.20	23.32	42.10	39.16
December	2012	6.75	54.28	65.39	61.87	28.70
	2013	12.62	28.80	21.09	21.34	26.09
Average		9.68	41.54	43.24	41.60	27.39
January	2013	7.42	26.25	29.17	26.04	25.05
	2014	9.71	59.02	59.25	44.44	35.81
Average		8.73	37.12	36.92	39.64	32.32
Seasonal average		120.476	57.213	45.516	34.690	41.990
	S.D	0.70	7.03	9.62	3.12	4.98
	S.E	0.40	4.05	5.55	1.80	2.88
Correlation with atmospheric factors						
Temp.		-0.69	-0.93	-0.86	0.13	1.00
R.H.		-0.94	-0.46	-0.35	-0.28	0.50
Wind Velocity		0.94	0.44	0.46	0.44	-0.70
Analysis of variance						
Sources of variation		**df**	**S.S**	**M.S**	**F.value**	**F.table**
Between months		2	68.12	34.06	calculated value at 5%	
Between sites		4	1934.25	483.56	0.58	4.46
Error		8	463.64	57.95	8.34	3.84
Total		14	2466.01	-	-	-

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