



ISSN NO. 2320-5407

Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/13209
DOI URL: <http://dx.doi.org/10.21474/IJAR01/13209>



RESEARCH ARTICLE

THE STUDY OF PHYSICOCHEMICAL CHARACTERISTICS IN TREE BARK OF *ACACIA NILOTICA* L. WITH REFERENCE TO AIR POLLUTION AT INDORE, MADHYA PRADESH, INDIA

Priya Trivedi¹, Jeetendra Sainkhediya² and Sukhalal Muwel³

1. Department of Botany Compfeeders Aisect College of Professional Studies, Indore, M. P., India.
2. Department of Botany Govt. PG College Sendhwa Dist. Barwani, Madhya Pradesh, India.
3. Department of Botany Govt. PG Bhagat Singh College, Jaora (M.P.), India.

Manuscript Info

Manuscript History

Received: 25 May 2021

Final Accepted: 29 June 2021

Published: July 2021

Key words:-

Acacia Nilotica L., Physicochemical Characteristics, pH, Electrical Conductivity

Abstract

The atmosphere might seem limitless but about 95% of the air is contaminated with first 12 -15 KM above the earth surface. The quality of the air gets deteriorated as a result of emissions of contaminants from all the man's activities including energy generation, manufacturing of goods and disposal of waste. Thus, to evaluate the effect of Air pollution on physicochemical characteristics a comparative study was undertaken in tree bark of *Acacia nilotica* L. with reference to different pollution area of Indore city. The result showed the variation in pH values which was recorded from 4.7 to 6.9. The lowest pH 5.0 was found at MPA and VPA in rainy season. Electrical conductivity was higher at all pollution areas. Highest value of electrical conductivity was recorded at VPA in rainy season 297.3 $\mu\text{mohs}/\text{cm}^2$. While maximum % increase over LPA was seen in summer season at polluted area.

Copy Right, IJAR, 2021,. All rights reserved.

Introduction:-

In about last 150 years there occurred a fast deterioration of air, water and soil quality that ultimately resulted in the environmental crisis. Air pollutants once released from the source cannot be checked, treated or curtailed and thus travel long distances and may adversely affect plants, animals and human being. In India is at 7th place among industrially developed countries. The population density increased around industrial and urban areas. For fast transportation number of auto vehicles also increased rapidly. All these have posed serious environmental problems. As a result, plant which is growing in its natural habitat is generally exposed to fluctuating levels of different pollutants. This level may exceed at any time to the level demonstrated to cause injury (**Feder, 1973**). In case of trees not only foliar surface but bark also absorb and accumulate the air pollutants. Bark is also exposed to environment for reaction with air pollutants as it provides a very large surface area next to leaves. In comparison to leaves where the surface is mostly smooth, in bark it is rough. Over the rough surface of bark chances of pollutants absorption and accumulation are more and may change bark characteristics like pH and electrical conductivity etc. The accumulation of air pollutants in bark is purely a physio-chemical process. The pollutants either passively accumulate on the surface of the bark or become absorbed through ion exchange processes in the outer parts of the dead cork layer (**Walken horst et al. 1993, Schulz et al. 1999**). Many ecologists made use of tree bark as a bioindicator (**Staxang 1969, O' Hare 1974, Grether 1977, Grodzinska 1982, 1987, Marmor and Randlane 2007 and Steindor et al. 2011**). So far the effect of ambient air pollution on tree bark is concerned, it remained mostly untouched not only at Indore, but in other parts of country.

Corresponding Author:- Priya Trivedi

Address:- Department of Botany Compfeeders Aisect College of Professional Studies, Indore, M. P., India.

Description of Experimental trees

Babul (*Acacia nilotica* L.) is useful in rural and urban area for various works.

Pollution areas

Pollution areas were selected on the basis of sources and nature of pollutants. Four areas were selected as mentioned below

Mixed pollution area (MPA)

This area is located in scheme No.78.

Vehicular Pollution area (VPA)

It is a part of Eastern ring road between Khajarana to Bengali square.

Industrial pollution area (IPA)

Sanwer Road, Industrial cluster situated on Ujjain road.

Low pollution area (LPA)

Ralamandal village. It is considered as reference area.

Materials and Methods:-

Bark was the main material for present work. Bark samples of experimental trees specie were collected in triplicate in all three seasons i.e. rainy (August), winter (December) and summer (April) in years 2015 and 2016. About 2 to 5 mm thick chips of bark were removed by sharp knife from all the directions around the tree at a height of 5-6 feet above the ground level and placed in a zipper poly bag. For uniformity trees of same height, canopy and main trunk size were selected at all polluted area. Bark samples of same tree species were also collected from low polluted area which serves as control or reference for comparison. The samples were brought in the laboratory for the further analysis.

Measurement of pH and Electrical conductivity

For measuring pH and conductivity aqueous extract was prepared. Bark samples were oven dried at 105° C for about 24 hours. 5 grams of dried sample was grinded and soaked with 100ml of distilled water for 48 hours. The pH and electrical conductivity of the bark extract was determined following (Grodzinska, 1971) using Digital pH meter EI – 112 and Digital conductivity EI-611 meter respectively.

In above data from table 1 and plate 1 it is evaluated that there is a change morphology, color, and Texture at all different polluted area. Presence of Lichen and Bryophytes can be seen at low polluted area which indicate low value of SO₂ whereas in contrast to that deposition of pollutants can be seen at the vehicular polluted and Industrial polluted area indicate the presence of pollutants at high level. The bark extracts pH of *Acacia nilotica* growing at different pollution areas are presented in **Tables 2 and 3**. In general average pH values were found to be acidic mostly in rainy season at all pollution areas. Variation in pH values were recorded from 4.7 to 6.9. On an average the lowest pH 5.0 was found at MPA and VPA in rainy season. Although bark is a solid material & cannot have a pH, bark pH refers to the pH of unbuffered aqueous solution in contact with the bark (Kricke, 2002). The bark extract pH clearly indicates the nature of pollutants predominating in the study areas. Increased acidity of bark pH in vehicular polluted area can be linked with high sulphation rates. The predominance of SO₂ accompanied with NO_x in both vehicular and industrial polluted area and mixed polluted area appear to be responsible for the increasing acidic nature of the bark. In present study bark pH was recorded more acidic in rainy season in comparison to summer & winter. However, earlier work done by Joshi (1989) and Wagela (1998) reported more acidic nature of bark in summer & winter seasons at Indore. Hartel (1982) noticed that dry bark absorbed more SO₂ than moist which results in more acidic nature of bark. Treshow (1971) also suggested that in dry season SO₂ long lived and settled down slowly with aerosols and dust. Hence, it is possible that in summer season dry bark may have absorbed more SO₂ & NO_x and thus become more acidic and this has appeared in rainy season. Electrical conductivity of barks extracts in *Acacia nilotica* at different pollution areas are presented in tables 3. In *Acacia nilotica* electrical conductivity was higher at all pollution areas. Highest value of electrical conductivity was recorded at VPA in rainy season 297.3 µmohs/cm². Area wise and seasonally lower electrical conductivity was seen at LPA in summer season which was 126.0 µmohs/cm². Likewise maximum % increase over LPA was seen in summer season at polluted area. Electrical conductivity is far more sensitive indicator of air pollution than bark pH. It changes even at

small emission of SO₂ which normally do not produce change in bark pH. As per **Kreiner and Hartel (1986)** the electrical conductivity of bark is mainly due to the presence of sulphate and other compounds.

Table 1:- Physicochemical characteristics of *Acacia nilotica* bark for different pollution areas.

S.NO.	Character	LPA	MPA	VPA
1.	Morphology	Rough	Rough	Rough
2.	Colour	Blackish	Blackish grey	Brown
3.	Texture	Deep vertical furrows	Deep vertical furrows	Deep vertical furrows
4.	Special	lichen and bryophytes present	Very small patches of lichen present	Absent

Table 2:- Bark extract pH of *Acacia nilotica* growing in different pollution areas of Indore city in different seasons.

Pollution areas	Year	Rainy	Winter	Summer
LPA	2015	6.9	6.6	6.5
	2016	6.7	6.1	6.2
	AV±SD	6.9±0.1	6.4±0.4	6.4±0.2
MPA	2015	5.1	6.0	6.3
	2016	4.8	6.3	6.1
	AV±SD	5.0±0.2	6.2±0.2	6.2±0.1
VPA	2015	5.1	5.3	5.6
	2016	4.8	4.7	6.1
	AV±SD	5.0±0.2	5.0±0.4	5.9±0.4
IPA	2015	5.5	5.4	5.4
	2016	5.2	5.2	5.9
	AV±SD	5.4±0.2	5.3±0.1	5.7±0.4
	Correlation	-0.999	-0.542	-0.381

Table 3:- Electrical conductivity of *Acacia nilotica* Bark growing in different pollution areas of Indore city in different seasons ($\mu\text{mohs}/\text{cm}^2$).

Pollution areas	Year	Rainy	Winter	Summer
LPA	2015	243.0	210.0	125.0
	2016	248.0	212.9	127.0
	AV±SD	245.5±3.5	211.5±2.1	126±1.4
MPA	2015	262.9	254.0	145.0
	2016	267.0	258.9	146.0
	AV±SD	265.0±2.9	256.5±3.5	145.5±0.7
VPA	% Increase	7.94%	21.27%	15.47%
	2015	299.0	225.0	175.0
	2016	295.6	228.0	176.0
IPA	AV±SD	297.3±2.4	226.5±2.1	175.5±0.7
	% Increase	21.09%	7.09%	39.28%
	2015	280.0	250.0	205.7
	Correlation	0.941	0.944	0.997

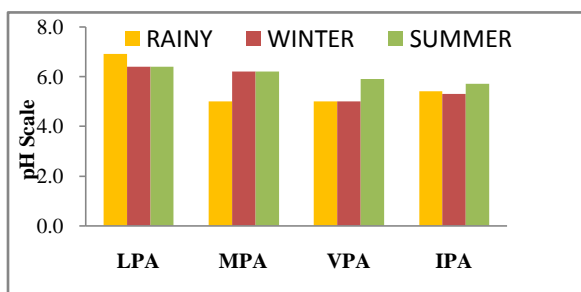


Fig. 1:- Seasonal changes in pH

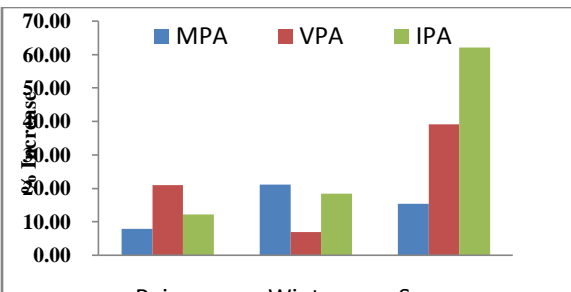
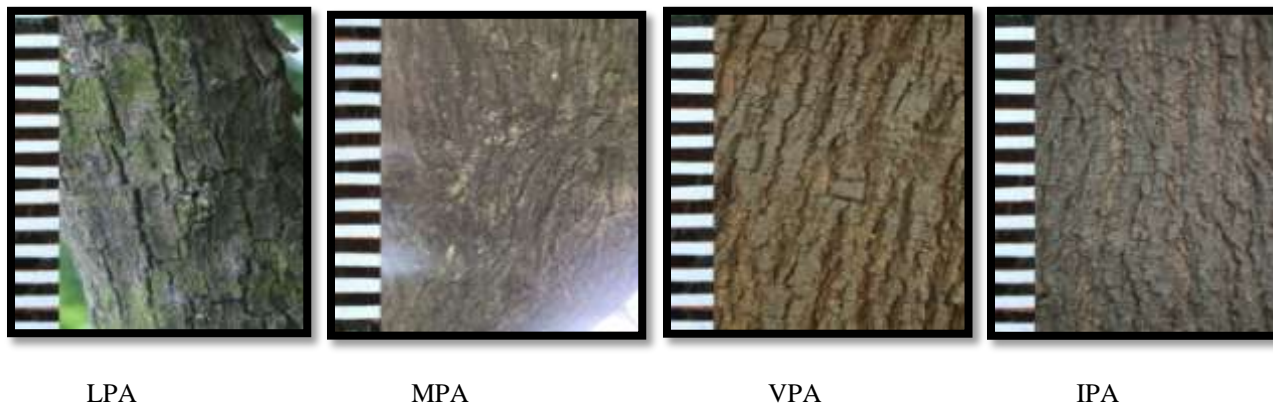


Fig. 2:- Seasonal changes EC

Fig. 3:- Showing bark of *Acacia nilotica* growing at different pollution areas.

Acknowledgement:-

I am thankful to UGC CRO, Bhopal for financial support. I am also thankful to Principal and Head of Botany department PMB Gujarati Science College, Indore for providing the research facilities. I would like to express my special appreciation and profound gratitude to my esteemed supervisor Dr. O.P. Joshi, Retired Principal PMB Gujarati Science College, Indore and Co-supervisor Dr. Kishore Pawar, Head Department of Seed Technology, Holkar Science College, Indore and Dr. Dilip Wagela, Senior Scientist, M.P. PCB Indore for their guidance, valuable suggestions, inspiration, elaborative discussions and encouraging advice.

References:-

1. Feder, W.A. (1973). Cumulative effects of chronic exposure of plants to low level of air pollutants. In : Air pollution damage to vegetation . Advance in chemistry, series No.122. Ed. J.A. Nagrere Americal Chemical Society Washington. pp.: 21 – 30.
2. Grether, D. F. (1977). The effect of high stock coal burning power – plant on the relative pH of superficial bark of hard wood trees. Water, Air and soil pollut. ;07.
3. Grodzinska, K. (1978). Acidity of tree bark as a bioindicatorof forest pollution in Southern Poland .Water, air and soil pollution ; 8 : 3-7.
4. Grodzinska, K. (1987) : Monitoring of air pollutants by mosses and tree bark. In :Steubing L. &Jager H.-J.(eds) Monitoring of air pollutants by Plants. DrW.Junk Pub., The Hague : 33-42.
5. Grodzinska, K. (1971). Acidification of tree bark as a measure of air pollution in Southern Poland. Bull. Acad. Pol. Sci. Cl. II, ; 19 : 189 – 195.
6. Grodzinska, K. (1982). Monitoring of air pollutants by mosses and tree bark. In :Steubing L. &Jager H.-J.(eds) Monitoring of air pollutants by Plants. Dr W. Junk Pub.The Hague : 33-42.
7. Härtel O, Grill D (1972). Die Leitfähigkeit von Fichtenborken-Extraktenals empfindlicher indicator für luftverunrrinigungen. Eur J. Pathol. ; 2 : 205– 215.
8. Härtel O'. (1982). Pollutants accumulation by bark. In: Steubing L &Jäger H-J (eds) Monitoring of air pollutants by plants. Dr. W. Junk Publishers, The Hague ; pp. : 137-147.
9. Huhn G, Schulz H, Stärk H-J, Tölle R &Schüürmann G (1995). Evaluation of regional heavy metal deposition by multivariate analysis of element contents in pine tree barks. Water, Air, and Soil Pollution ; 84: 367-383.

10. Joshi O.P. (1989) : Evaluation of air pollution damage due to sulphur dioxide. Ph.D. Thesis Devi Ahilya University, Indore.
11. Joshi, O. P., Pawar, K. and Wagela, D. K. (1993). Air quality monitoring of Indore city with special reference to SO₂ and tree barks pH. *J. Environ. Biol.* ; 14:2:157 – 162.
12. Kreiner, W. & Hartel, O. (1986). Spruce bark influenced by SO₂. *Eur. J. For. Path.* 16:171-181.
13. Kricke, R. (2002). Measuring Bark pH. Monitoring with Lichens. 333 - 336.
14. Marmor, L. and Randlane, T. (2007). Effect of road traffic on bark pH and epiphytic lichens in Tallinn. *Folia cryptog. Estonica, Fasc.*; 43 : 23 – 37.
15. O' Hare, G.P. (1974). Lichen and bark acidification as indicator of air pollution in West Central Scotland. *J. Biogeogr.* 2 :135 – 146.
16. Schulz, H., Popp, P, Huhn, G., Stärk, H-J. & Schüürmann, G. (1999). Bioimonitoring of airborne inorganic and organic pollutants by means of pine tree barks. I. Temporal and spatial variations. *The Science of the Total Environment.* ; 232: 49-58.
17. Staxang, B. (1969). Acidification of bark of some deciduous trees, *Oikos* ; 20 : 224 – 230.
18. Steindor, K., Palowski, B., Góras, P., Nadgórska-Socha, A. (2011). Assessment of bark reaction of select tree species as an Indicator of acid gaseous pollution. *Pol.J. environ.Stud.* 20:3:619-622.
19. Treshow, M. (1971). *Environment & Plant Response*. Mc. Grew Hill Book Com. New York.
20. Wagela, D.K. (1998). Assessment of air pollution effects on plants and soils in and around Indore due to automobile emissions. Ph.D. Thesis, Devi Ahilya University, Indore.
21. Walkenhorst, A., Hagemeyer, J., Breckle, S.W. and Markert, B. (1993) . Passive monitoring of airborne pollutants, particularly trace metals, with tree bark. In: Markert B (ed) *Plants as biomonitors: Indicators for heavy metals in the terrestrial environment*. VCH Ver.Ges., Wein., Germany . 523-540.