 

# Evaluation of the Air Quality of Two Cites in the Niger-Delta, Delta State Nigeria

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**Abstract**
The air quality of two cities in the Niger-Delta, Delta State, Nigeria was assessed via the Air Pollution Tolerance Indices (APTI) of plants. This is a bio-monitoring technique using the biochemical parameters of the plant species. Twenty plant species were taken from each city along the major highways in the cities. Standard methods of analysis were employed for leaf extract pH, leaf extract total chlorophyll, ascorbic acid content of leaf and the relative water content of leaf. The APTI were then computed of the different plant species according to standard procedure. The APTI values for the cities ranged from 3.18 – 8.27 for Abraka and 4.28 – 9.45 for Ughelli. The mean APTI value for Abraka was 5.69 ±0.35 and Ughelli, 7.28 ±0.32. The result showed that the air quality in Ughelli is more compromised when compared with that of Abraka. Using the students't-test, there was a significant difference between the qualities of air in these cities. It is therefore recommended that tolerant plant species be planted in these areas to mitigate air pollution and improve the quality of air.
**Keywords**: Ughelli, Abraka, APTI, Air Quality, Niger – Delta

## 1. Introduction

Air pollution is the alteration of the natural air constituent to the extent that it affects both man and the environment. Several workers have attributed air pollution to urbanization and industrialization (Babu *et al.* 2013; Kumar & Kousar 2015; Nwadinigwe 2014; Begum & Harikrishna, 2010; Agbaire, *et al.,* 2013). Babu *et al. (* 2013) opined that air pollution is in fact an inevitable consequence of industrialization and urbanization. Increased industrialization is usually accompanied with increased consumption of fossil fuel needed for transportation, machineries and other human activities which would eventually lead to release of increase gases and particulates into the atmosphere which will ultimately lead to air pollution. It has also been observed that air pollution could be as a result of inadequate planning for the environment, especially in third world countries (Okunola *et al.* 2012). Since air pollution affects both man and properties, it is therefore imperative to monitor the air quality of living things as well as the environment. Several methods are available for monitoring air quality. These include the physiochemical methods which might not be able to show the impact of air pollution on plants, animals and monuments (Subba – Rao 2005), hence the need for bio monitoring.

Bio monitoring can be used effectively to monitor air pollution as well as monitoring its impact on vegetation (WHO, 2000). Plants are generally used for this bio monitoring. Plants are continually exposed to air pollution since then are generally stationary and so the effect on them is usually proportional to the intensity of exposure to air pollutants. Studies have shown that exposure of plants to air pollution resulting in changes in the anatomy, physiology or biochemistry of plants. Therefore the continuous monitoring of certain biochemical parameters of plants can be indicative of the degree of air pollution within an environment. The sensitivity to air pollution, however varies from one plant species to another, hence some are termed tolerant (show no or nominal symptoms) and other sensitive (show evident symptoms). Therefore plants can be used as bio-monitors and bio-indicators of air pollution. Tolerant plants species act as an air pollution sink since these can withstand stress to a great extent and so could be used as phyto-remediating agents in a polluted environment. This is important to horticulturist, landscapers and environmental health practitioners. Therefore plants species are not just chosen for their aesthetic values, but also for health concerns. Sensitive species on the other hand, are bio-indicators and so could be used to monitor air quality. Plants can remove gaseous pollutants by update via leaf stomata during the course of their normal activities. They can also remove particulate pollutant by intercepting the airborne particle and retaining them on the leaf surface as dry deposition. Studies have shown the impact of air pollution on the following biochemical factors in plants, ascorbic acid content (Hogue *et al.* 2007); leaf extract pH (Klumpp *et al.* 2000); total chlorophyll content (Flowers *et al.* 2007); and relative water content (Rao 2006). It has also been observed that these individual factors did not give a reliable representation of the air quality since they gave conflicting results in some plant species (Han *et al.* 1995). They further observed that the Air Pollution Tolerance index was better and more dependable property for the assessing of air quality. The Air Pollution Tolerance Index is a species dependent quality which is inherit in plant to mitigate air pollution stress (Palit *et al.* 2013). Air Pollution Tolerance Index can be computed using the formula shown below (Sing & Rao 1983).

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

A = Ascorbic acid content (mg/g)

T = Total chlorophyll content (mg/g)
P = pH of leaf extract
R = Relative water content (%)
The APTI has been used by several workers to classify plant species as well as monitor the air quality (Moham 2013; Agbaire *et al.* 2014; Tanee & Albert 2013; Krishnaveni & Magesh 2014; Babu *et al.* 2013, Qudir & Siddiqui, 2014; Kumar & Kousar 2015; Jain & Kutty 2014 & Kousar, *et al.* 2014). Agarwal, *et al.* (1991) classified plants, thus; APTI<10 sensitive, 10-16 intermediate, ≥ 16 tolerant. This study is therefore to assess the air quality of two cities in the Niger-Delta, Delta State, Nigeria using the APTI

## 2. Material and Methods

Sampling procedures and methods employed are according to standard methods as described by Agbaire *et al.,* 2014. Twenty plants species were collected along the highways from the two cities. The cities are Ughelli and Abraka, Ughelli is located along latitude 5° 59' E and Abraka along latitude 5° 47' N and 6° 60' E.

## 3. Result and Discussion

Results are presented in Table – 1 and Table – 2
The pH of leaf extracts ranged from 4.30 – 7.75 (Ughelli) and 4.45 – 6.90 (Abraka). These pH values are indicative of an acidic medium. The acidic nature of the leaf extract is indicative of the nature of the air pollutants present. It indicates the acidic nature of the pollutants. Acidic pollutants such as $SO_2$ and $No_x$ diffuse and forms acid radical in the leaf matrix when it reacts with the cellular water. Chlorophyll content which is an index of productivity is adversely affected by acidic pH. In this study, the chlorophyll content range 0.18 – 0.20 in both cities. This indicates low productivity. Ascorbic acid is a stress reducing factors and a strong reducing agent. The pH value affects the ascorbic acid content since it affects the efficiency of conversion of Hexose sugar to ascorbic acid (Escobedo *et al*. 2008). A high pH (acidic) increases this conversion. High ascorbic acid content is usually associated with tolerant plant species. The relative water content is an index of the hydration condition in plant species. The relative water content usually affects the leaf extract pH.

**Table 1: APTI of Plant Species From Ughelli Metropolis**

| s/n | Plant Species | R | T | P | A | APTI |
|---|---|---|---|---|---|---|
| 1. | *Manihot esculenta* | 74.22 | 0.20 | 6.60 | 1.0 | 8.10 |
| 2. | *Ocimum grattissimum* | 61.08 | 0.20 | 5.60 | 1.0 | 6.69 |
| 3. | *Hevea brasiliensis* | 77.93 | 0.20 | 5.60 | 1.0 | 8.37 |
| 4. | *Woodwardis fimbriata* | 57.44 | 0.20 | 5.20 | 1.0 | 6.28 |
| 5. | *Hydrophyllacea phacellia* | 82.63 | 0.20 | 5.40 | 1.0 | 8.82 |
| 6. | *Colocasia esculenta* | 68.37 | 0.20 | 6.15 | 1.0 | 7.47 |
| 7. | *Psiduim guajava L.* | 61.53 | 0.18 | 5.35 | 1.0 | 6.71 |
| 8. | *Centrosema pubescens* | 37.28 | 0.20 | 5.30 | 1.0 | 4.28 |
| 9. | *Carica papaya* | 84.71 | 0.20 | 5.55 | 1.0 | 9.05 |
| 10. | *Plantago major* | 66.03 | 0.20 | 5.30 | 1.0 | 7.15 |
| 11. | *Heteropogan contortus* | 47.69 | 0.20 | 5.40 | 1.0 | 5.33 |
| 12. | *Chromolaena odorata* | 89.27 | 0.20 | 5.00 | 1.0 | 9.45 |
| 13. | *Vernonia amygdalina* | 88.42 | 0.20 | 5.55 | 1.0 | 9.42 |
| 14. | *Saccharum officinarum* | 68.51 | 0.20 | 6.80 | 1.0 | 7.55 |
| 15. | *Pennisetum purpureum* | 63.00 | 0.18 | 6.00 | 1.0 | 6.92 |
| 16. | *Citrus sinensis L.* | 42.37 | 0.19 | 6.15 | 1.0 | 4.87 |
| 17. | *Dendrocalamus calostachyus* | 74.46 | 0.19 | 4.30 | 1.0 | 7.89 |
| 18. | *Sida acuta* | 66.86 | 0.19 | 7.25 | 1.0 | 7.43 |
| 19. | *Hibiscus rosa sinensis* | 64.24 | 0.19 | 6.65 | 1.0 | 7.11 |
| 20. | *Helianthus annuus* | 61.19 | 0.19 | 5.95 | 1.0 | 6.73 |

**Table - 2 Air Pollution Tolerance Index of Plants in Abraka**

| s/n | Plant Species | R | T | P | A | APTI |
|---|---|---|---|---|---|---|
| 1. | *Manihot esculenta* | 66.42 | 0.19 | 6.20 | 0.38 | 6.88 |
| 2. | *Ocimum grattissimum* | 56.64 | 0.19 | 6.30 | 0.11 | 5.74 |
| 3. | *Hevea brasiliensis* | 75.32 | 0.19 | 5.85 | 0.18 | 7.64 |
| 4. | *Woodwardis fimbriata* | 39.71 | 0.19 | 5.65 | 0.06 | 4.01 |
| 5. | *Hydrophyllacea phacellia* | 73.64 | 0.19 | 5.45 | 0.06 | 7.40 |
| 6. | *Colocasia esculenta* | 63.40 | 0.19 | 6.35 | 0.08 | 6.40 |
| 7. | *Psiduim guajava L.* | 40.27 | 0.19 | 5.35 | 0.25 | 4.17 |
| 8. | *Centrosema pubescens* | 36.40 | 0.18 | 6.35 | 0.32 | 3.85 |
| 9. | *Carica papaya* | 80.94 | 0.19 | 6.65 | 0.25 | 8.27 |
| 10. | *Plantago major* | 47.08 | 0.19 | 5.65 | 0.03 | 4.73 |
| 11. | *Heteropogan contortus* | 35.60 | 0.20 | 6.45 | 0.12 | 3.64 |
| 12. | *Chromolaena odorata* | 72.85 | 0.19 | 5.95 | 0.11 | 7.35 |
| 13. | *Vernonia amygdalina* | 49.50 | 0.18 | 6.15 | 0.19 | 5.07 |
| 14. | *Saccharum officinarum* | 64.25 | 0.19 | 6.15 | 0.14 | 6.51 |
| 15. | *Pennisetum purpureum* | 33.98 | 0.19 | 5.75 | 0.82 | 3.89 |
| 16. | *Citrus sinensis L.* | 30.67 | 0.19 | 6.25 | 0.18 | 3.18 |
| 17. | *Dendrocalamus calostachyus* | 70.21 | 0.19 | 4.45 | 0.15 | 7.09 |
| 18. | *Sida acuta* | 64.50 | 0.19 | 6.90 | 0.19 | 6.58 |
| 19. | *Hibiscus rosa sinensis* | 53.22 | 0.20 | 6.40 | 0.10 | 5.39 |
| 20. | *Helianthus annuus* | 60.11 | 0.19 | 5.95 | 0.10 | 6.07 |

The higher the relative water content the more dilute the solution is and since the pH affects other biochemical parameters in the plant, there is a very close relationship of these factors since these parameters affect the plant anatomy and physiology, or biochemistry, it is therefore linked to air quality. The combination of these factors to give the air pollution tolerance index in Ughelli ranged from 4.28 to 9.45 while that of Abraka ranged from 3.18 to 7.64. The student's t-test showed a significant difference between the two cities. The mean APTI for Abraka was 5.69 ±0.35 while Ughelli had 7.28 ± 0.32

## CONCLUSION

The result showed a definite gradient in the air quality in the two towns with Ughelli showing to be more compromised than that of Abraka

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