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# Relationship between Vegetation and Pollen Spectrum in South East Nigeria

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## Abstract

*Modern pollen rain has been considered important in simulating the vegetation of an area; this is attributed to the fact that airborne pollen released into the atmosphere represents the vegetation around the area of study. Monitoring of airborne pollen in three contiguously lying areas in Nsukka plateau was carried out from October to December, 2015. The aim was to study the vegetation and assess the possible simulation of the vegetation of Nsukka Plateau through airborne pollen. Airborne samples were trapped using modified Tauber-like pollen Traps, the recipient solutions were subjected to standard acetolysis protocols. Thirty – four pollen types belonging to 19 families were identified. Dominant pollen include Alchornea cordifolia (Schum. and Thonn) Mull.-Arg, Elaeis guinensis Jacq., Syzygium guineense (Willd.) DC., Amaranthaceae/Chenopodiaceae and Asteraceae sub Tubuliflorae complex. Pollen recorded in Aku and Lejja were more diverse with predominance of arboreal pollen. Quantitatively the pollen from Savanna taxa were the highest pollen contributors of 4265(62.09 %). There was no significant different P>0.05 in the absolute pollen and fungal spores counts in the three contiguous areas. The recovered pollen reflected distinctive sub-vegetation types among the contiguous areas which are relics of Lowland Rainforest and derived Savanna ecotype.*

**Keywords:** Palynomorphs, Simulation, Vegetation, Lowland Rainforest, Nsukka.

## Introduction

Pollen grains are male reproductive units and are released into the air in huge amount for the purpose of pollination. The concentration of different pollen types in the atmosphere varies enormously among different areas of the same country, because pollen emissions depend on the vegetation structure and meteorological conditions[1]. Several factors have contributed to the usefulness of pollen in accessing the vegetation of an area, pollen grains are abundantly produced and widely distributed than any other plants parts[2], because of their sizes and their aerodynamic properties. During the flowering seasons, which are practically the whole year in the tropics, the air is laden with pollen grains. Their amounts vary depending on whether the air is dry or moist.

The quantity of pollen grain is greater on dry windy days than on wet rainy days, because wind dislodges freshly released pollen(Ezike et al In press) In time, the loss of height and velocity result in their being precipitated on all surfaces such as fields, roads, forests, roof-tops, sea or even on human beings and vehicles[2]. Among other parts of a plant, pollen grains are the most resistant to decay and to actions of strong chemicals. Their remarkable resistance and aero dynamism are properties that make possible the application of pollen in paleoenvironmental reconconstruction[2].

The distance of pollen dispersal depends on air temperature, humidity, pollen sinking speed, changes in surface topography and the force and direction of the prevailing winds[3]. The succession of pollen which invade the atmosphere represent the vegetation around the area of study[4], this also furnishes valuable information regarding its hay fever causing potential[5]. The variations in the abundance of pollen grain in the atmosphere from year to year have been reported by Hyde[6] as well as Davies and Smith[7]. These variations could be related to variations in the flowering intensity and pollen productivity due to climatic variations[6]. Knowledge of pollen released is relevant to the study of flowering and in developing a functional model for forecasting pollen concentration. Earlier studies in Nsukka on airborne pollen include Agwu[4] and Njokuocha 2006, these works laid a platform for the comparison with the present work. The aim of this study was to assess the airborne pollen distribution and abundance in three contiguously lying locations in Nsukka plateau and examine their relationship with the vegetation.

## Materials and Methods

**Study Location:** The study was conducted in the three contiguously lying locations in Nsukka Plateau consisting of Aku; (06$^o$ 69$^1$ N ; 007$^o$ 33$^1$E; Alt.350 m), Lejja (06$^o$ 77$^1$ N;007$^o$ 39$^1$E; Alt. 420 m ) and Ohodo (06$^o$ 74$^1$N ; 007$^o$ 41$^1$ E; Alt. 474 m). These areas lie within the humid tropical region with average monthly temperature fluctuating between 24°C and 29°C. Nsukka Plateau is generally characterized by a derived Savanna[9], that is located between the true Guinea Savanna in the north and the tropical rainforest belt in the south of Nigeria. It forms a part of the mosaic of Lowland Rainforest and secondary Grassland[10] which stretches east to west across the country with its widest in the north-south extension located in the Nsukka plateau area. The climate is characterized by alternating rainy season (May-October) and dry season (November-April). The dry season is accentuated in its dryness caused by the dust bearing harmattan wind (NE) from December and January. The major winds during the dry and rainy seasons are the NE trades and the SW mosoon respectively. The Inter-Tropical Discontinuity (I.T.D.) fluctuates in its position within the West Africa region from the coastal margins at 4° N to about 8° N latitude during the dry season[11].

**Sample Collection:** Tauber like pollen traps were employed for the collection of airborne pollen, each trap was placed in a hole dug in the ground so that the collar and cover were above the surface of the ground. A ring of stones was tightly wedged around the trap to stabilize the immediate ground surface level (Figure-1), solution made up of 50 ml of glycerol, 10 ml of formaldehyde and 5 ml of phenol was prepared and poured into the trappers and placed in the sampling locations. The recipient solutions were collected and replaced monthly over a period of three months.

The samples were stored in the refrigerator to avoid any ongoing oxidation of plant materials. The recipient solutions were sieved through 200 µ mesh wire gauze to filter off large organic particles. The liquid with the suspended pollen were centrifuged at 2000 revolutions per minute (RPM) for 5 minutes. The supernatants were decanted and the residues retained. The precipitates were washed three times with water and centrifuged again in order to recover the polliniferous residues. The residues recovered from the above were each placed in a plastic test tubes and 45% hydrofluoric acid was added to each[12]. This suspension was allowed to stand for 15 minutes. The residues were washed three times with water and were acetolyzed according to a modified version of Erdtman's[13] procedures. The recovered residues were stored in vials with two drops of glycerine. Temporary slides were prepared and examined using light Olympus microscope (LM) fitted with a motic camera MC 2000 at x 400 and x 100 magnifications. Identification was based on comparism with reference collections of pollen slides, description and photomicrographs of pollen and spores in books and journals e.g Y'bert[14].

The data obtained were analyzed using the SPSS statistical package version 20 (SPSS Inc. Chicago, Illinois USA). Descriptive and frequency statistics and correlation coefficients were generated.

**Figure-1**
**Tauber-like pollen Trap in the field**

## Results and Discussions

A total of 11,224 palynomorphs were recovered from the aero samples trapped from the studied locations. Aku contributed 4216, Lejja and Ohodo achieved 3493 and 3515, respectively. Thirty four pollen types belonging to 19 families of flowering plants were recorded (Table-1). The sum of the pollen trapped during the three months totaled 6,869. Pollen count decrease from October (3515) to November (3195) and increased in December (4563). Other palynomorphs recorded include fungal spores, charred Poaceae epidermis, Pteridiophyte spores, algal cysts/cells, they constituted 39.27 %, 6.11 %, 8.57 %, 0.17 %, respectively out of the total palynomorphs recorded.

A high diversity of the floristic composition of Nsukka was deciphered from the pollen assemblages. Though pollen count is an approximate and fluctuating measure, yet it serves as an indicator of the species diversity of the vegetation zone. The number of taxa recorded in this work for three months could be compared to; a record of 44 genera belonging to 33 families recovered in six months[4] and 40 genera belonging to twenty-six families recovered in 12 months in two sampling sites[8] in Nsukka plateau. The record is comparatively higher than previous work and could be attributed to increase in sampling locations. This does not only portrayed the heterogeneous nature of airborne pollen, but a reflection of the number of plant species in flower during the study period (October- December, 2004). Pollen from dicotyledonous families dominated monocotyledonous families due to the preponderance of the species of the former in Nsukka plateau.

**Dominant Palynomorphs:** Pollen were the most dominant palynomorphs recorded in the three areas. Fungi were next to pollen in abundance (Figure-2). However, the fungal spores recorded in October at Lejja 1 and Aku 1 was higher than pollen recovered from the same locations (Figure-3). Most dominant pollen which were preponderant in the three locations include those of Amararthaceae/Chenopodiaceae, *Alchornea cordifolia*, *Cyperus* spp., *Elaeis guineensis*, Poaceae, Asteraceae sub Tubuliflorae complex. Pollen types and abundance varied among the contiguous areas. Some of the dominant pollen recorded were also recorded by Njokuocha[8] in his studies in the atmosphere of the University of Nigeria, Nsukka and Nnamani and Agwu[15] from honey samples from Nsukka. The disparity in the type species and composition could be due to distance between the studies locations.

**Table-1**
**Absolute pollen counts and pollen concentration of each phytoecological group in the three contiguous locations in Nsukka plateau**

| | | AKU | | | LEJJA | | | OHODO | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TROP.LRT** | **FAMILIES** | **Oct** | **Nov** | **Dec** | **Oct** | **Nov** | **Dec** | **Oct** | **Nov** | **Dec** | **Total** | **%** |
| 1. *Alchornea cordiforlia* (Schum and Thonn.) Mull-Arg | Euphorbiaceae | 10 | 0 | 35 | 9 | 0 | 40 | 1 | 0 | 0 | 250 | 3.63 |
| 2. *Senna* spp. | Fabaceae | 26 | 0 | 10 | 2 | 1 | 1 | 1 | 0 | 0 | 44 | 0.64 |
| 3.*Eugenia nodiflora* Aubl. | Myrtaceae | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0.10 |
| 4. *Elaeis guineensis* Jacq. | Arecaceae | 285 | 300 | 320 | 110 | 64 | 131 | 80 | 13 | 143 | 1642 | 23.90 |
| 5.*Ficus* spp. | Moraceae | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0.07 |
| 6.*Gloriosa superba* L. | Liliaceae | 0 | 5 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 7 | 0.10 |
| 7.*Lannea acida* A. Rich. | Anacardiaceae | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0.14 |
| 8.*Microdesmis* spp. | Euphorbiaceae | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.01 |
| 9.*Milicia excels* (Welw.) C.C. Berg | Moraceae | 0 | 1 | 26 | 0 | 0 | 0 | 0 | 15 | 0 | 34 | 0.49 |
| 10.*Olax viridis* Oliv. | Olacaceae | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0.16 |
| 11.*Phyllanthus amarus* Schum and Thonn. | Euphorbiaceae | 2 | 0 | 0 | 0 | 0 | 0 | 13 | 14 | 10 | 41 | 0.60 |
| 12.*Pycnanthus angolensis* (Baill,) Warb. | Myristicaceae | 25 | 0 | 0 | 1 | 8 | 0 | 11 | 0 | 2 | 47 | 0.68 |
| 13.*Irvingia wombolu* Baill. | Irvingiaceae | 15 | 0 | 30 | 1 | 0 | 2 | 0 | 0 | 0 | 48 | 0.70 |
| 14.*Albizia zygia* (DC.) J. F. Macbr. | Fabaceae | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 0.02 |
| 15.*Cochlospermum* spp. | Cochlospermaceae | 0 | 0 | 0 | 1 | 13 | 0 | 0 | 0 | 0 | 14 | 0.20 |
| 16.*Ritcheia* spp. | Capparidaceae | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0.01 |
| 17.*Spondias mombin* L. | Anacardiaceae | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0.01 |
| 18.*Spathodea* sp. | Bignoniaceae | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 3 | 0.04 |
| 19.*Carpolobia* sp. | Polygalaceae | 0 | 0 | 0 | 1 | 16 | 2 | 0 | 0 | 0 | 19 | 0.27 |
| 20. Amarathaceae/Chenopodiaceae | Amarathaceae/ Chenopodiaceae | 65 | 0 | 0 | 64 | 12 | 4 | 7 | 0 | 0 | 159 | |
| **Total** | | 535 | 306 | 442 | 293 | 129 | 185 | 134 | 33 | 260 | 2589 | 35.37 |

**SAVANNA TAXA**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21. Poaceae | Poaceae | 200 | 210 | 390 | 14 | 269 | 273 | 315 | 580 | 363 | 4485 | 65.29 |
| 22. *Syzygium guineense* (Willd.) DC | Myrtaceae | 43 | 0 | 0 | 2 | 0 | 1 | 1 | 0 | 0 | 50 | 0.73 |
| 23.Cmbretaceae/Melastomataceae | Cmbretaceae/Melastomataceae | 1 | 0 | 0 | 4 | 0 | 2 | 0 | 0 | 6 | 13 | 0.19 |
| 24. Senna spp. | Fabaceae | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.01 |
| 25. *Hymenocardia acida* Tul. | Euphorbiaceae | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 9 | 0.13 |
| 26. *Parkia biglobosa* Benth. | Fabaceae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0.09 |
| 27.*Lophira lanceolata* Tiegh. Ex Keay. | Ochnaceae | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 15 | 0 | 1 | 0.01 |
| **Total** | | 245 | 210 | 390 | 20 | 269 | 276 | 321 | 580 | 369 | 4265 | 62.09 |
| | | | | | | | | | | | | |
| **HUMAN IMPACT** | | | | | | | | | | | | |
| 28. Asteraceae sub-Tubuliflorae complex | Asteraceae | 15 | 15 | 15 | 0 | 2 | 37 | 5 | 0 | 0 | 90 | 1.31 |
| 29. *Justicia* sp. | Acanthaceae | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 2 | 0.03 |
| 30.*Casuarin equisetiforlia* L. | Casuarinaceae | 1 | 3 | 1 | 1 | 0 | 0 | 2 | 1 | 0 | 10 | 0.15 |
| 31. *Anacardium occidentale* L. | Anacardiaceae | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 1 | 2 | 17 | 0.25 |
| 32.*Cucumis* sp. | Cucurbitaceae | 0 | 0 | 0 | 37 | 0 | 0 | 0 | 0 | 0 | 37 | 0.54 |
| 33.*Ricinus communis* L. | Euphorbiaceae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0.17 |
| 34.*Luffa aegyptica* Mill. | Cucurbitaceae | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 6 | 0.09 |
| **Total** | | 16 | 18 | 16 | 38 | 6 | 38 | 14 | 2 | 3 | 174 | 2.53 |
| **Pollen grand total** | | 796 | 534 | 848 | 351 | 404 | 499 | 469 | 615 | 632 | 6869 | 61.19 |
| | | | | | | | | | | | | |
| **OTHER PALYNOMORPHS** | | | | | | | | | | | | |
| 35. Fungal spores | | 492 | 546 | 550 | 692 | 297 | 685 | 451 | 518 | 177 | 4408 | 39.27 |
| 36.Pteridiophyte spores | | 3 | 65 | 165 | 125 | 42 | 86 | 20 | 15 | 165 | 686 | 6.11 |
| 37.Charred Poaceae epidermis | | 5 | 65 | 132 | 10 | 30 | 270 | 32 | 64 | 354 | 962 | 8.57 |
| 38.Algal cysts/cells | | 15 | 0 | 0 | 2 | 0 | 0 | 3 | 0 | 0 | 20 | 0.17 |
| **Total** | | 23 | 130 | 297 | 137 | 72 | 356 | 55 | 79 | 519 | 1668 | 0.15 |
| **Palynomorphs grand total** | | **1311** | **1210** | **1695** | **1180** | **773** | **1540** | **975** | **1212** | **1328** | **11224** | |

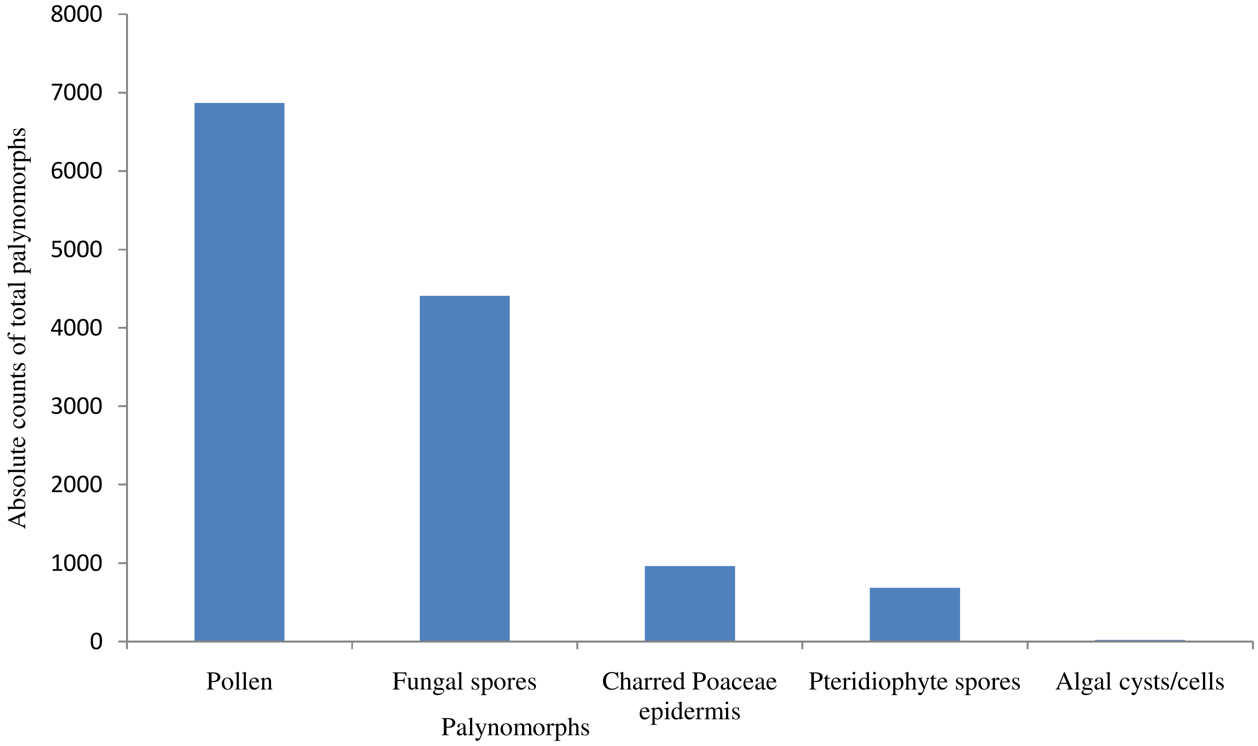


**Figure-2**
**Total palynomorphs recorded in the three contiguous areas in Nsukka plateau**

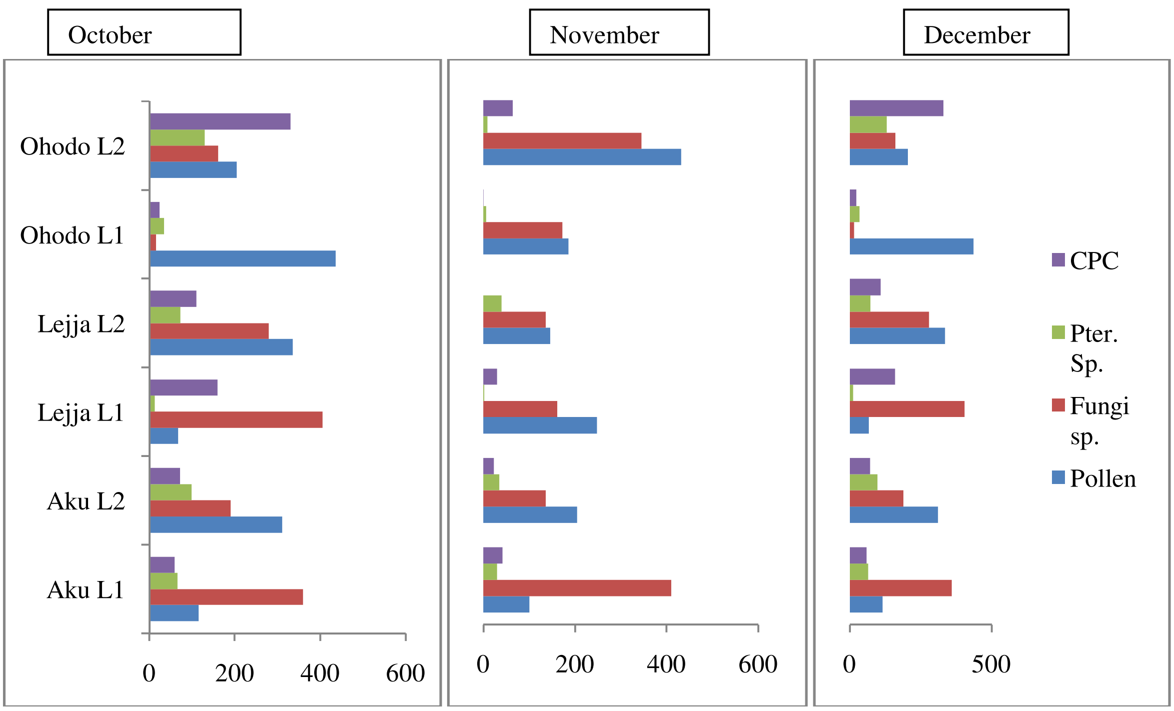


**Figure-3**
**Monthly counts of different palynomorphs in the study areas**

There were no significant differences in absolute pollen, fungal spores, charred Poaceae, epidermis and algal cyst/cell counts in the three contiguous areas (Table-2). The pteridiophyte spores recorded in Lejja in the month of October differed significantly from those in Aku and Ohodo.

**Dominant Pollen Dispersion in the Contiguous Areas:** The preponderance of pollen dispersed from *Alchornea cordiforlia*, *Cassia* spp., *Irvingia wombolu* in Aku reflected presence of mature nature forest vegetation sub-type in flower, a result of tropical Lowland Rainforest which Phil-Eze[16] stated are found in prominent patches in the area.

Pollen dispersed from Amarathaceae/Chenopodiaceae, *Elaeis guinensis*, Poaceae were more dominant than other pollen recorded in Lejja and Ohodo, this depicted presence of mosaic open Farmlands/ Oil Palm forest species in flower in the area at the period of sampling. The preponderance of *Elaeis guinensis* in all locations reflected the abundance of palm trees in Nsukka Plateau, Agwu[4] and Njokoucha[8] also indicated high preponderance of *Elaeis guineensis* pollen in Nsukka plateau. The low pollen input of *Albizia zygia*, *Gloriosa superba*, *Ritcheia* sp., *Spondias mombin*, *Spathodea* sp. *Senna* spp., *Nauclea latifolia*, *Lophira lanceolata* among others were due to their entomophilous nature or their active flowering period not coinciding with the sampling period.

*Elaeis guineensis* and Poaceae were the most prolific pollen producers in the study areas within the study period, they achieved 1642 (23.90 %) and 4485 (65.29 %), respectively out of the total pollen count. Poaceae pollen was the most dominant Savanna species recovered from the atmosphere of the three contiguously lying areas. The grasses copiously dispersed pollen into the atmosphere from many sources such as wild and cultivated but with varying intensity in the months. Lejja 1 and Ohodo 2 showed marked decreases in number of Poceae pollen trapped in December with a corresponding abrupt increase in the number of charred Poaceae epidermis, which showed evidence of their being burnt after post anthesis. In other locations; Aku 1 and 2, Lejja 2, Ohodo 1, the number of Poaceae pollen recorded in December were relatively high in spite of high level of charred Poaceae epidermis encountered, these increases could be attributed to long distance transportation of Poaceae by the North-East wind (Harmattan wind). Charred Poaceae epidermis reflects the extent of anthropogenic activities in the area such as burning of grasses in preparation of the planting season or hunting. These activities were more in December than the two previous months.

In overall, pollen morphotypes which belong to Tropical lowland Rainforest in flower were more preponderant than those of Savanna and indicators of human impact, their monthly summations showed they were more abundant in the month of December though, their abundance varied among locations. Pollen from Tropical lowland taxa were trapped more in Aku 2 in the months of October and December than other locations (Figure-4), Ohodo location 1 made the least contributions of pollen from Tropical lowland taxa in the month of November. Aku 1 and Ohodo 1 made the highest contributions of pollen from Savanna taxa in December (Figure-5). The taxa abundance was a reflection of the vegetation type in flower from October to December in the sampling locations.

**Table-2**
**Distribution of different palynomorphs in the contiguous locations of Nsukka Plateau**

| | **AKU** | | | **LEJJA** | | | **OHODO** | | |
|---|---|---|---|---|---|---|---|---|---|
| Palynomorphs | **Oct** | **Nov** | **Dec** | **Oct** | **Nov** | **Dec** | **Oct** | **Nov** | **Dec** |
| Pollen | 368±52 | 273±50 | 422±82 | 205±77 | 197±51 | 202±189 | 232±34 | 309±123 | 320±115 |
| Fungal spores | 246±11 | 273±14 | 275±85 | 346±55 | 148±13 | 342±63 | 225±39 | 259±86 | 89±73 |
| Pteridiophyte sp. | 2.50±.5 | 33±3 | 83±17 | 63±8* | 21±19 | 43±30 | 10±9 | 8±2 | 82±48 |
| CPE | 3±3 | 33±10 | 66±6 | 5.0±5.0 | 15±15 | 135±25 | 16±13 | 32±32 | 177±15 |
| Algal cysts/cells | 7.5±7.5 | 00±00 | 00±00 | 00±00 | 00±00 | 00±00 | 00±00 | 00±00 | 00±00 |

Values are expresses as means ±S.E.M. for n =5, *Significant at P<0.05, O-October, N-November, D-December, CPE-Charred Poaceae epidermis

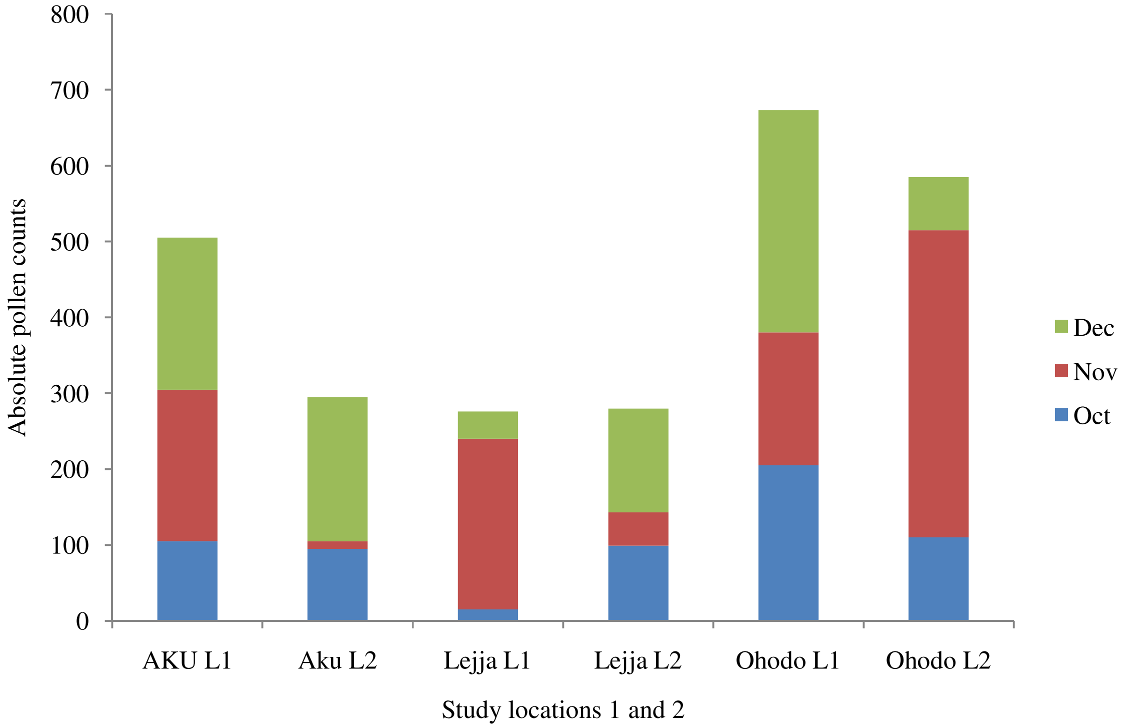


**Figure-4**
**Monthly records of pollen recovered from Tropical lowland Rainforest taxa**

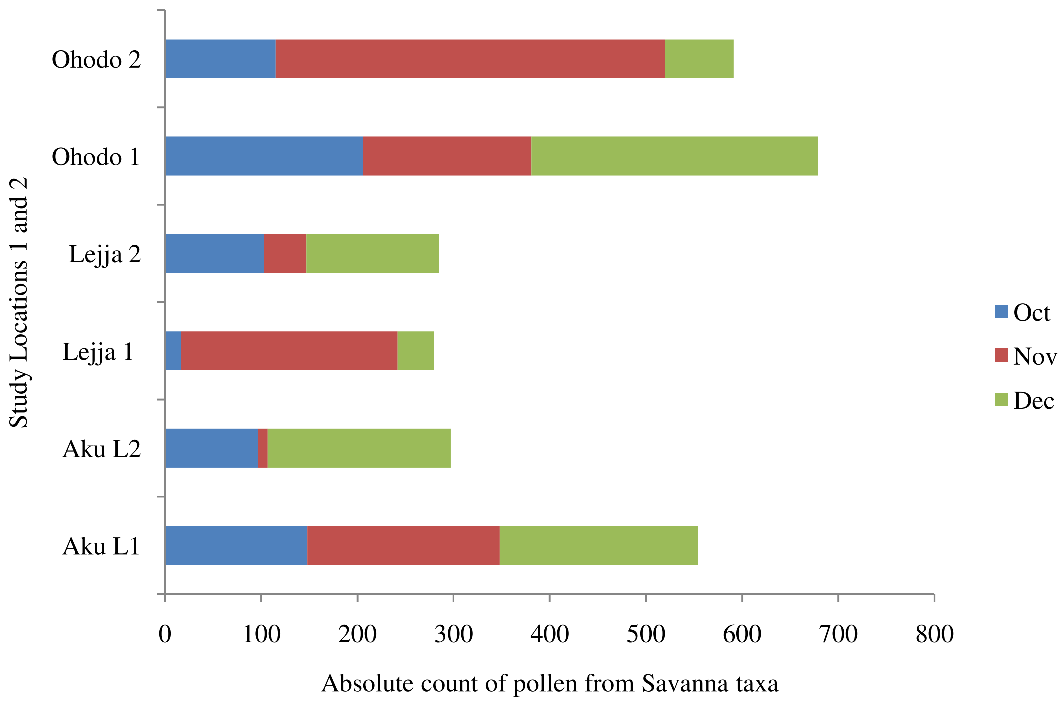


**Figure-5**
**Monthly record of pollen recovered from Savanna taxa**

Indicators of human impact include those of *Ageratun conyzoides*, *Casuarina equisetiforlia*, *Asteracea* sub Tubuliflorae complex, *Cucumis* sp., *Ricinus communis* among others. A total of 148 pollen from indicators of human impact were recorded which represented 2.53% of the total pollen. They were more abundant in Lejja 74(6.4%) than Aku 57 (2.98%) and Ohodo 20 (1.15%). The high influx of *Casuarina equisetiflorlia* recorded by Agwu[4] and Njokuocha[8], was not encountered in the present work and could be attributed to the distance between the sampling sites (more than 200 km apart). Frenze[7] demonstrated that the size of source area represented by a pollen sampler depends on the distance between the sampler and the nearest vegetation. Airborne pollen concentrations exhibit spatial variability, as pollens from nearby vegetation exert a profound local influence[17]. Moreover, the absence of exotic pollen from the aero samples shows lack of introduction of pollen by long distant transport in all the studied locations.

The month of October had the least pollen record in Aku 1 and Ohodo 2. In November, Lejja 1 and Ohodo 2 had more pollen than the other months. The pollen types and abundance varied among the studied locations. In December greater number of palynomorphs were recorded in all locations. Pollen transported by the North-East wind(harmattan wind) in addition to the main flowering period of most trees, shrubs and wild herbaceous plants, input of phytoliths contributed to the increase in December. Multitude of these organic particles wafted into the atmosphere especially in December could cause respiratory allergies and environmental hazard to human.

**Relationship between Palynomorphs and Weather Parameters:** Pollen abundance in the atmosphere were influenced by prevailed meteorological parameters. Total pollen counts and most dominant pollen correlated negatively with rainfall and relative humidity but positively with temperature (Table-3). This is in concordance with Hussen[8], who found correlation between pollen concentration in the atmosphere of Ahha city, Saudi Arabia and air temperature and a negative correlation of pollen concentration with rainfall, relative humidity and wind velocity. This also agrees with Agwu[4], who recorded more pollen in the atmosphere of Nsukka during the less rainy months. This findings are also related to the views of Barnes *et al.*[19], Teranishi et al.[20], Riberio et al.[21], Njokuocha[8], who found that airborne pollen concentration significantly correlated with temperature and wind direction and negatively correlated with rainfall and number of rainy days.

Other palynomorphs recorded include fungal spores, pteridiophyte spores, charred Poaceae epidermis, algal cysts/cells, insect parts. Pteridiophyte spores were represented lower than pollen and fungi spores. They are sporadically represented in the atmosphere, this may be due to the herbaceous nature of most ferns that shrivel during the dry season and do not sporulate except those inhabiting humid environment. More pteridiophyte spores were released into the atmosphere in December more than the two previous months probably due to stronger action of wind supporting the view of Calleja et al.

## Conclusion

The analysis of airborne samples revealed the atmospheric pollen content in flower from October to December 2004. The floristic composition had some resemblance in the components of dominant pollen but there were sub –vegetation types among the contiguous areas which were relics of Tropical Lowland Rainforest and Secondary Grassland. Poaceae and *Elaeis guineensis* were the most prolific pollen producer. The dominant and persistence presence of charred Poaceae epidermis reflects the extent of bush burning in Nsukka Plateau. Pollen dispersed into the atmosphere was influenced by prevailed meteorological parameters. In overall pollen recovered depicted the typical vegetation of Nsukka Plateau.

**Table-3**
**Correlation coefficients between pollen counts and meteorological parameters**

| **Pollen count** | **R** | **R.H** | **T** |
|---|---|---|---|
| Total pollen | -.799 | -.812 | .910 |
| Amarathaceae/Chenpodiaceae types | .995 | .997 | -.993 |
| *Alchornea cordiforlia* | -.841 | -.853 | .938 |
| Cyperaceae | .417 | .397 | -.211 |
| *Elaeis guineensis* | -.036 | -.059 | .251 |
| Poaceae | -.668 | -.651 | .492 |
| Asteraceae types | -.856 | -.868 | .948 |

R, Mean monthly rainfall (mm); T, Mean monthly temperature ($^oC$); R.H, Mean monthly relative humidity (%); Mean monthly wind speed (km/hr)

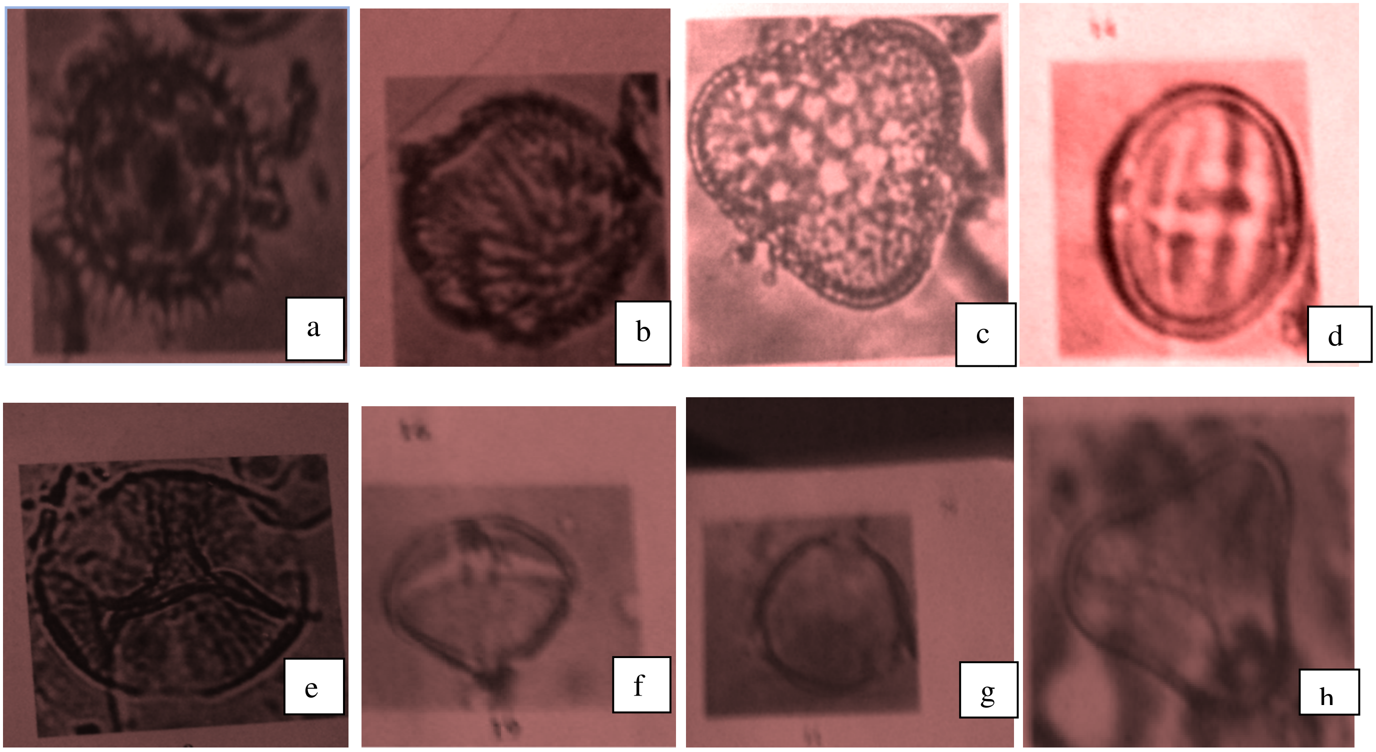


**Figure-6**
**Photomicrographs of some pollen. a, Asteraceae sub Tubuliflorae complex. b, *Lannea acida*, c, *Ceiba petandra*. d, *Trichilia* sp.. e, *Spondias mombin*. F,*Cassia* sp.. g, *Pentaclethra macrophylla*. h, *Elaeis guineensis***

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