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Research Article

Aeropalynological Study of Anyigba, Kogi State, Nigeria

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Abstract

Airborne palynomorphs of Anyigba, Kogi State, Nigeria were acetolysed and analysed palynologically to determine the taxa of biological importance present in the atmosphere. Out of sixty- one (61) pollen types belonging to thirty-six (36) plant families encountered, fifty (50) were identified to species level. Five (5) to family level and one (1) were unidentified. A total of 10356 pollen grains, 9491 fungal spores, 308 pteridophyte spores, 238 diatoms, 60 dinoflagellate cysts, 66 algal cysts, 1533 charred Poaceae cuticle/ trichomes, 3371 burnt plant epidermis and 324 insects/ insect parts were counted. The predominant pollen types include those of Poaceae, *Elaeis guineensis* Jacq, *Lannea acida* A.Rich, *Nauclea latifolia* S.M., *Alchornea cordifolia* Sw, *Syzygium guineense*, *Berlinia grandifolia, Senna* sp., members of the Asteraceae tubiliflorae complex and Combretaceae/ Melastomataceae families. All these are characteristic species of the Forest- Savanna ecozone. The presence of pollen record of *Corylus avellana*, *Encephalartos* sp., *Ecbolium* sp. and *Ilex* sp. is a valid evidence of long distance transport. The excessive increase in the relative abundance of burnt plant parts is an indication of annual bush fire and residual precipitation associated with the vegetation of the study area. The presence of burnt plant parts and fungal spores in the atmosphere from aesthetic plants affirms the great influence of anthropogenic activities on the local vegetation. This study would provide a good template which could be used to monitor the frequency and intensity of indiscriminate bush fire and other anthropogenic activities in the surrounding savanna vegetation and provide adequate restoration and conservation measures for safety health and environmental sustainability.

Keywords: Aeropalynology, Palynomorphs, Acetolysis, Anyigba, Nigeria.

INTRODUCTION

Aeropalynology is the scientific study of biological particles such as pollen, fungal spores, dust mites, insect debris and organic dust present in the air (Hyde, 1972). Another point of interest in the study of aeropalynology is the very important discovery that certain taxa caused allergic reactions in some people. Therefore, knowledge of the kind and type of pollen or spores in the air or sample has medical implications (Agwu and Osibe, 1992). Aeropalynology also involves the study of the release, dissemination, deposition and allergic effects of pollen grains and spores present in the air. It has been well established for more than a century that pollen grains are responsible for many allergic diseases, such as hay fever, asthma, allergic rhinitis, and atopic dermatitis (Knox, 1993; Agashe, 1994).

The use of pollen and spores in environmental studies is primarily in its application to the study of vegetational history. Conclusion about climate and human disturbances could be deduced from such analysis and they are termed secondary deductions (Erdtman, 1969). Fact gathered from such analysis could be useful to climatologists and oil explorationists among others (Moore and Webb, 1983). Aeropalynological studies have also revealed the effects of rainfall, humidity, temperature, wind speed and direction on the relative concentration of palynomorphs in the atmosphere (Agwu and Osibe, 1992; Agwu, 1997).

Airborne fungal spores are minute, unicellular or multicellular reproductive bodies released into the atmosphere mostly

by the action of winds and raindrops. They are among the most abundant and least well known of airborne allergens. Many fungi depend exclusively on wind regime for their spores release and dispersal. This makes it vital to study the seasonal and diurnal periodicities of these airborne fungal spores over a given period (Njokuocha and Osayi, 2005). The abundance and periodic occurrences of fungal spores is also affected by the availability of host plants in the vegetation (Richardson and Ellis, 2000). In Nigeria, most fungal spore genera recorded in airborne palynomorphs studies have also been identified in other countries as allergens of various sensitizations to human (Sanchez and Bush, 2001). Recently, it has been well documented that air-borne pollen grains and spores widely cause various allergic complaints such as hay fever, eczema and asthma (Burge and Rogers, 2008).

The distribution of acritarchs, chitinozoans, dinoflagellates, cysts, pollen and spores provides evidence for stratigraphical correlation through biostratigraphy and palaeoenvironmental reconstruction (Moore and Webb, 1978; Hooghiemstra and Agwu, 1986; Davies and Bunting, 2010; Njokuocha, 2012). Anyigba, is a university sub-urban town located in the Eastern Senatorial District of Kogi State, Nigeria. Anyigba lies approximately between latitude $7^{0}30^{1}$N and longitude $7^{0}15^{1}$E. It is surrounded by smaller towns, villages and homesteads whose inhabitants have impacted on the environment in many ways. Map of the study area is shown in Figure1.

The study is aimed at determining the taxa of biological importance present as airborne particles in the atmosphere of Anyigba and to compare the pollen assemblage with that of the flora of Anyigba, Dekina Local Government Area, Kogi State, Nigeria.

MATERIALS AND METHODS

Eight locations were selected within Anyigba, Dekina Local Government Area of Kogi State, Nigeria as sampling sites. These sites were chosen for safety and convenience reasons. At each site, a pollen trap (Modified Tauber Sampler) was buried in the ground in such a way that the collar was about 4cm above the ground level according to the method of Tauber(1977). Prior to this, a mixture of glycerol (65ml), formalin (30ml) and phenol (5ml) was poured into each of the trap. The positions of the traps at various locations were recorded using a Global Position System (GPS). The solutions in the trap prevented the palynomorphs from drying up, kill insects and also prevented the decay of dead organisms. The trap was left to stand throughout the duration of the study period. At the end of every two weeks of each month, solution collection was done and the traps thoroughly washed with water to prevent any contamination and are then recharged with the above mentioned chemical solution. This procedure was repeated bi-monthly from March- December (covering both the dry season sampling and the rainy seasons) for one year. The periodic one year palynomorphs collected with the pollen samplers were recovered through centrifugation at 2000 r.p.m (revolution per minute) for 5 minutes and supernatant decanted each time. The precipitates were washed twice with distilled water and recovered through centrifugation. The sediments were treated with glacial acetic acid to remove water before acetolysis. Acetolysis mixture was freshly prepared in a ratio of 9:1 from acetic anhydride and concentrated sulphuric acid. Acetolysis was carried out by boiling the palynomorphs in a water bath at 100^{0}C (Erdtman, 1969; Agwu and Akanbi, 1985). The mixture was placed in water–bath at 100°C for 5 minutes, stirred and then centrifuged for 5 minutes and supernatant decanted. The recovered precipitates were washed with glacial acetic acid, and finally washed twice with distilled water, centrifuged each time and decanted. The recovered palynomorphs were stored in a plastic vials in glycerin and ethanol solution (2:1).

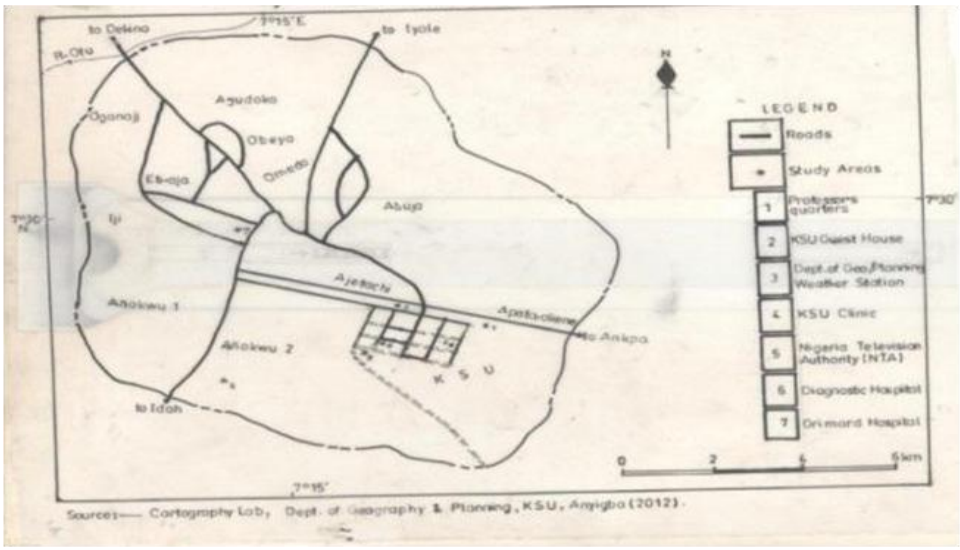

Figure 1. Map of Anyigba showing study areas

One drop of thoroughly shaken palynomorphs suspension was mounted on microscope slide and covered with an 18×18mm cover slip. The mount was sealed off with colourless nail varnish to prevent drying up of the palynomorphs. The prepared slide was then examined microscopically with Olympus microscope at x400 magnification for counting and Leica microscope at x1000 magnification for detailed morphological studies. Palynomorphs identification, counting and classification was done with the help of reference descriptions and photomicrographs from Agwu and Akanbi (1985); Bonnefille and Riollet (1980); Barnett and Hunter (1998); Sowunmi (1978); Sowunmi(1995), and Zillinsky (1983).

RESULTS AND DISCUSSIONS

A total of 10356 pollen grains, 238 diatoms, 9491 fungal spores, 308 fern spores, 60 dinoflagellate cysts, 66 algal cysts, 1533 charred Poaceae cuticle/ trichomes, 3371 burnt plant epidermis, and 324 insects/ insect parts were counted (Table 1). Generally, the concentration of palynomorphs in the atmosphere is generally modulated by some meteorological factors (Table 2) such as rainfall, temperature, relative humidity, wind speed and direction, source location, sampling site, season of flowering and sporulation.

Table 1. Pollen/SporesSpectrum of Anyigba for the Study period (March- December, 2012)

POLLEN/ BIOPARTICLES TYPE	MAR	APR	MAY	JUN	JUL	AUG.-OCT.	NOV.	DEC.	TOTAL	MEAN MONTH
Pollen grains	699	1249	2593	1401	801	611	1490	1512	10356	1294.462
Fungal spores	1753	1046	1113	1268	1059	1020	685	1547	9491	1186.375
Fungal hyphae	11	3	2	2	2	-	2	8	30	3.75
Pteridophyte spores	21	23	32	47	120	51	14	-	308	38.5
Algal cysts	13	18	14	10	-	-	11	-	66	8.25
Dinoflagellate cysts	9	21	11	5	-	-	2	12	60	7.5
Diatoms (*Cerataulina sp*.)	25	52	99	21	-	-	17	24	238	29.75
Burnt Plant Epidermis	372	324	172	106	69	21	181	2126	3371	421.375
Charred Poaceae Cuticle	95	61	11	19	25	9	52	1261	1533	191.625
Johnson grass smut	11	3	615	6	-	-	40	88	763	95.375
Insects/ insect part	63	24	62	11	17	7	10	130	324	40.5
TOTAL TRAP BIOPARTICLE	3055	3085	4733	2880	1843	1483	2543	6918	26540	3317.462

Table 2. Mean Monthly Distribution of Climatic Elements over the Environment of the Study Area (2012)

PARAMETERS	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP	OCT.	NOV.	DEC.
Rainfall (mm)	0.00	0.7	0.0	3.7	4.0	6.1	4.4	6.2	10.3	4.3	1.2	0.0
Mean temp.(˚C)	20.7	23.4	25.5	24.6	23.4	22.7	21.9	21.7	21.6	21.7	22.3	22.1
Relative humidity (%)	82.0	84.9	84.7	86.7	81.7	82.2	83.1	82.6	82.1	82.1	81.7	83.8
Wind Direction(W.D)	N/E	S/W	S/W	S/W	S/W	S/W	S/W	S/W	S/W	S/W	N/E	N/E
Wind Speed Km/h (W.S.D)	-	-	4.7	4.0	3.8	3.7	4.0	3.7	4.1	3.9	3.6	4.4

SOURCE: Meteorological Station, Dept. of Geography and Planning, KSU, Anyigba (2012).

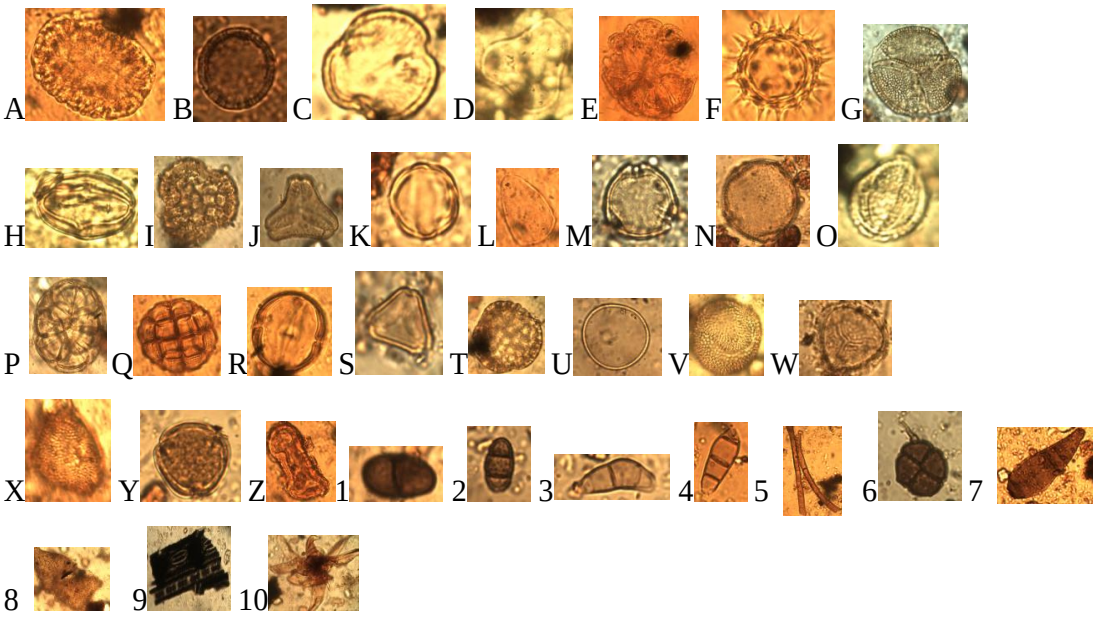

Figure 2. A- *Ecbolium sp.*; **B-***Amaranthaceae/ Chenopodiaceae*; **C-** *Lannea acida*; **D-***Elaeis guineensis*; **E-** *Rauvolfia vomitoria*; **F-** *Asteraceae*; **G-** *Newbouldia laevis*; **H-***Senna sp.*; **I-** *Delonix sp.*; **J-** *Tessmannia sp.*; **K-** *Combretaceae/ Melastomataceae*; **L-** *Cyperaceae*; **M-** *Alchornea cordifolia*; **N-** *Hymenocardia acida*; **O-** *Phyllanthus sp.*; **P-** *Adenanthera pavonina*; **Q-** *Albizzia zygia*;**R-***Trichilia prieureana*; **S-** *Syzygium guineense*; **T-** *Eriosema sp.*; **U-** *Poaceae*; **V-** *Talinum triangulare*; **W-** *Pteris dentata*; **X-** *Morelia senegalensis*; **Y-** *Solanum melongena*; **Z-** *Pyconocycla sp.*; **1-***Botryodiplodia*; **2-***Pithomyces*; **3-***Curvularia*; **4-***Syncephalastrum*; **5-**Fungal hyphae; **6-***Dictyoarthrinium*; **7-***Dinoflagellate* cysts; **8-**Insect part; **9-**Burnt plant part; **10-** Bryophyte leaves.

In this study, it was found that the pollen load of the entire study area varied quantitatively and qualitatively not only from month-to-month but also from site-to-site. In the same way, atmospheric pollen studies conducted in various parts of the world showed that there were variations not only in monthly pollen concentration, but also site-to-site variations in monthly pollen content of major individual pollen types as regards maximum count (Rogers and Levetin, 1998; Monlina *et al*., 2001; Njokuocha and Ezenwajiaku, 2010). According to Singh and Babu (1981) the major variation noticed in the monthly pollen counts (of families) and individual pollen types at different sites suggests that the atmospheric concentration of pollen is influenced not only by the meteorological factors, but is essentially a function of the frequency, density and abundance of plant species as well as their flowering behavior at a given locality. For instance, in the present study, the higher values of *Elaeis guineensis*, *Lannea acida*, *Poaceae*, *Syzygium guineense*, *Ceiba pentandra*, *Paullinia pinnata*, *Berlinia grandifolia* and *Combretaceae/ Melastomataceae* pollen grains at location (L1) than at other sites may be largely due to the high density of these plants at these site than are present at other locations. The same explanation is applicable for the pattern of variation observed for other pollen types.

The high occurrence of pollen of the Poaceae family is an indication of the proximity of study area to the fringe of the guinea savanna belt of the core north, as reported by Agwu and Abaeze (1991). Moreso, Poaceae (grass family) pollen was the major contributor to the airborne pollen trapped in this study with a total of 4964 pollen grains. This finding is in line with the results of Njokuocha (1996) who reported that poaceae pollen was the major contributor to the atmospheric pollen content of Nsukka as well as other southeastern states of Nigeria. Anyigba is also known for the cultivation and production of oil palm and palm produce (*Elaeis guineensis*). Its abundance in the pollen spectra of the study area depicts extension of wooded grassland and traditional forest. The presence of pollen record of *Corylus avellana*, *Encephalartos* species and *Ecbolium* species is a valid evidence of long distance transport.

Analysis of variance for the various phytoecological indicator species shows that there was no statistical significant difference ($P>0.05$) between the pollen recorded for the various indicator species. Indicators of Savanna species were the highest pollen contributors. Results confirmed the vegetation of the study area to be Derived Savanna despite high level of anthropogenic activities.

In conclusion, the results of this study have shown the various phytoecological indicator species in the study environment; most of which are at the verge of extinction through series of anthropogenic activities. Such plants could be properly conserved and their exploitation managed to prevent extinction thereby enhancing biodiversity sustainability.

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