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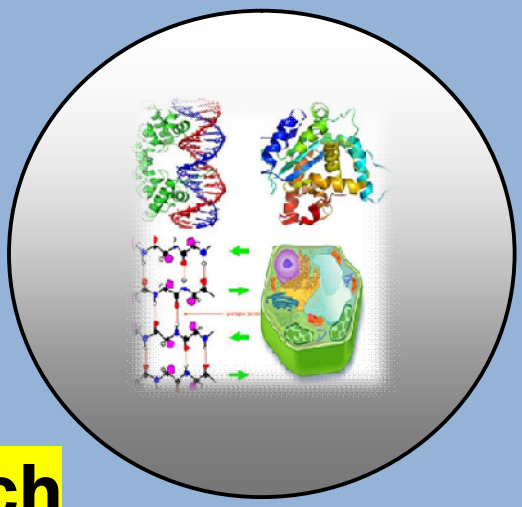

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RESEARCH PAPER

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A Study of Airborne Bioparticles of Anyigba Environment, Kogi State, Nigeria.

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ABSTRACT

Airborne bio particles of Anyigba environment, Dekina Local Government Area, Kogi State, Nigeria were acetolysed and analyzed palynologically to determine the taxa of biological and/or airborne particles present in the atmosphere. A total of 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 spore types include those of Botryodiplodia sp., Curvularia sp., Gliomastix sp., Dreschelia / Helminthosporium, Neurospora sp., Nigrospora sp., Pithomyces sp., Teliospore and Stemphylum sp. 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. Analysis of variance for the various airborne bio particles showed that there was no significant difference (P>0.05) between the various groups. This study would provide a good baseline information and data which could be used to monitor the frequency and intensity of indiscriminate bush fire in the surrounding savanna vegetation and provide adequate restoration and conservation measures for safety health and environmental sustainability.

Keywords: Airborne, Bioparticles, Palynological, Ecovegetational, Anyigba and Environment.

INTRODUCTION

Aerobiology is a branch of biological sciences that studies organic particles such as bacteria, fungal spores, very small insects and pollen grains which are passively transported by air (Spieksman, 1991). One of the main fields of aerobiology has traditionally been to measure and report quantities of airborne particles as a service to allergy sufferers (Larsson, 1993). Fungal spores are cosmopolitan in distribution and constitute a large proportion of the airborne palynomorphs trapped in most aeropalynological studies (Agwu, *et al*., 2004; Njokuocha and Ukeje, 2006). Fungal spores are of particular interest because of their association with plant diseases and pollinosis in man (Essien and Aina, 2014). Although fungal spores are widely distributed in the atmosphere, investigation shows that they are widely modulated by the prevailing weather condition (Calleja *et al*., 1993).Airborne particles are a major cause of respiratory ailments of humans, causing allergies, asthma, and pathogenic infections of the respiratory tract (Essien and Agwu, 2013; Essien and Aina, 2014). It has been reported by Essien (2014) that certain taxa of airborne particles caused allergic reactions in some people. Therefore, knowledge of the kind and type of these particles in the air or sample has medical implications. The use of pollen grains 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 these are termed secondary deductions (Erdtman, 1969; Faegri and Iversen, 1989). Facts gathered from such analysis could be useful to climatologists and oil explorationists among others (Moore and Webb, 1983).

Dinoflagellate cysts first appear abundantly and very recognizable in palaeo-palynological preparations of marine sediments in late Triassic. In the Jurassic, they are very abundant and very fast evolving making them ideal subjects for palynostratigraphy (Traverse, 1988). Diatoms are unicellular algae with a unique silica shell or frustule, which is readily preserved in sediments. Diatom frustules are often abundant and well represented and preserved in palynological preparations (Adekanmbi and Sowunmi, 2007).The report of a comprehensive and elaborate aerobiology of this nature in Anyigba environment is meagre and almost non-existing.

The study is aimed at determining the taxa of biological or airborne particles present in the atmosphere of Anyigba environment and the results of the investigations would provide a good baseline information and data which could be used to monitor the frequency and intensity of indiscriminate bush fire in the surrounding savanna vegetation and would also proffer adequate restoration and conservation measures for safety health and environmental sustainability.

MATERIAL AND METHODS

The Study Area

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 in numerous ways have left their impact on the environment.

Sampling Techniques

Eight locations were selected within Anyigba, Dekina Local Government Area of Kogi State, Nigeria as sampling sites. These sites were chosen for safety and security, logistic reasons and convenience of environmental analysis. 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 (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 bio particles 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. Fortnightly of each month, solution collection was done. The traps were washed with water to remove any contaminants and were then recharged with the above mentioned chemical solution. This procedure was repeated bi-monthly from March- December (dry season and the rainy seasons' samples) for one year.

The bioparticles (palynomorphs) 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 (Erdtman, 1969; Agwu and Akanbi, 1985; and Essien, 2014).The recovered precipitates were washed with glacial acetic acid, and finally washed twice with distilled water, centrifuged each time and decanted. The recovered bio particles were stored in a plastic vials in glycerin and ethanol solution (2:1).

The bioparticles were examined and analyzed palynologically and microscopically with Olympus microscope at x400 magnification for counting and Leica microscope at x1000 magnification for detailed morphological studies. Bioparticles 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); and Zillinsky (1983).

RESULTS AND DISCUSSIONS

On the basis of aerobiological investigation conducted in Anyigba, Dekina Local Government Area, Kogi State, Nigeria from March to December 2012, a very high concentration of airborne bio particles (palynomorphs) ranging from spores of fungi and pteridophytes (ferns), algal cysts, fresh water diatom frustules, dinoflagellate cysts, burnt plant epidermis/ trichomes, charred plant particles, feathers of insects/ insect parts, worms and chitinous exoskeleton were documented. Previous aeropalynological research carried out in West Africa (Calleja *et al.,* 1993; Melia, 1984; Agwu and Osibe, 1992; Agwu, 1997; Agwu *et al*., 2004) on the abundance, distribution and diversity of airborne palynomorphs and other particulate entities showed the existence of a large population of diverse organic and inorganic fractions in the atmosphere.

Diatoms

A total of 238 diatoms were encountered in the study (Table 1). The diatoms encountered in this study are fresh water species of the *Cerataulina sp*.

During prolonged dryness in Anyigba environment, ponds and other water logged areas dry up and expose the fresh water algae (diatoms) to strong harmattan winds. The wind waft up the dried mud into the air current (wave) causing an unusual increase in the atmosphere. The increase in fresh water diatom frustules, insect and plant debris in the areospora of Anyigba environment is an indication of increasing dryness and the arrival of long distance transported materials from Northeast (NE) trade wind otherwise known as Harmattan. Findings agrees favorably with the report of Essien *et al*., (2013) who opined that, in environmental analysis, diatoms are useful palaeoecological indicators with distinct ecological tolerance, and provides a substantial amount of autecological information's.

Dinoflagellate cysts

A total of 60 dinoflagellate cysts (Table 1) were encountered in the study. Their rich occurrences and diversity could therefore be linked with the Condensed Sections and associated Maximum Flooding Surfaces (MFS) which occur in River Niger, Lokoja and its environment during the period of this study. Findings corroborated favorably with the report of Hooghiemstra and Agwu (1986), who affirmed that dinoflagellates are marine phytoplanktons associated with transgressive and high stand regimes.

Fungal spores

A total of 9491 fungal spores were trapped in fairly large numbers (Table 1). Common among fungal spores identified include those of *Alternaria sp.*, *Botryodiplodia sp., Cerastosporium sp., Curvularia sp., Dreschelia/ Helminthosporium, Exosporium sp., Gliomastix sp., Neurospora sp., Nigrospora sp., Pithomyces sp., Stemphylium sp., Syncephalastrum sp., Teliospore,* and *Tetraploa*. The high degree of fungal spore occurrence in the atmosphere could be further associated with the large traits of maize farms as well as infected plants in and around Anyigba environment. It is evident to say that several allergic reactions of the eyes resulting in symptoms such as sneezing, runny/ itchy nose as well as itchy and watering eyes prevalent in Anyigba environment is as a result of the abundance and prevalence of different species of these aerospora. Richardson and Ellis (2000), reported similar findings and affirmed that some genera of these fungal spores are responsible for allergies such as rhinitis, pollinosis and exacerbation of asthmatic attack as well as pathogenic infections of the respiratory tract and are also implicated in nosocomial (hospital) infection of patients with solid organ transplants.

Pteridophytes spores

Fern spores trapped in this study totaled 308 with a slight increase from March (21) to August (51). During the dry season in Anyigba environment, most ferns and fern- like plants (*Pteris sp., Selaginella sp.* and *Lycopodium sp.*) die back and survive the inclement period through perennating rhizomes (Essien *et al*., 2013). The relatively low number of fern spores in the dry season could be attributed to a virtual absence of sporulation of ferns in the dry season (Table 1).

Arthropods

Apart from the regular fungal spores encountered, the study showed that all forms of arthropod particles such as insect and insects' parts as well as their moults were also trapped in the study. A total of 324 arthropod particles (insects/ insect parts) were encountered in the study (Table 1).

Essien and Aina (2014), reported similar findings in their study and opined that the presence of some of these organisms or their parts in the airborne spectrum of Anyigba can be interpreted to be vectors of parasites, while their parts are responsible for all forms of allergy when inhaled through the nose as well as exacerbation of asthmatic conditions.

Burnt plant parts

The plant debris recorded were mostly trichomes and epidermal tissue mostly of grasses and some xylem vessel element. A total of 3371burnt plant epidermis/ trichomes were encountered (Table 1). The occurrence and excessive increase in their relative abundance in the airborne spectra of Anyigba environment is an indication of annual bush fire and residual precipitation associated with the vegetation of the study area. The decrease in abundance of burnt plant epidermis/ cuticles from April (324) to October (21) depicts the decrease in available dry leaves especially after bush fire. The presence of burnt plant epidermis/ trichomes in the atmosphere of Anyigba environment affirms the great influence of anthropogenic activities on the local vegetation. Agwu (2001) reported similar findings and opined that, burnt epidermis and spores in the atmosphere are indices of the vegetation.

Charred Poaceae Cuticle

A total of 1533 charred poaceae cuticles were encountered in the study. A reduction in relative abundance of Charred Poaceae Cuticles from April (61) to October (9) depicts the decrease unavailable dry leaves especially after bush fire. During domestic and wild fire incidences, charred plant particles from grasses, shrubs, and trees wafted into the atmosphere. They serve as indicator of bush fire and they can be used in monitoring the intensity and frequency of bush fires.

Table 1. Monthly Bioparticles record of Anyigba Environment.

Spores/ Bioparticles trapped	MAR.	APR.	MAY	JUN.	JUL.	AUG.	NOV.	DEC.	TOTAL	MEAN
Fungal spores	1747	1310	1124	1254	811	784	726	1765	9521	1190.125
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 BIOPARTICLETRAPPED	2356	1836	2140	1479	1042	872	1053	5406	16184	2023

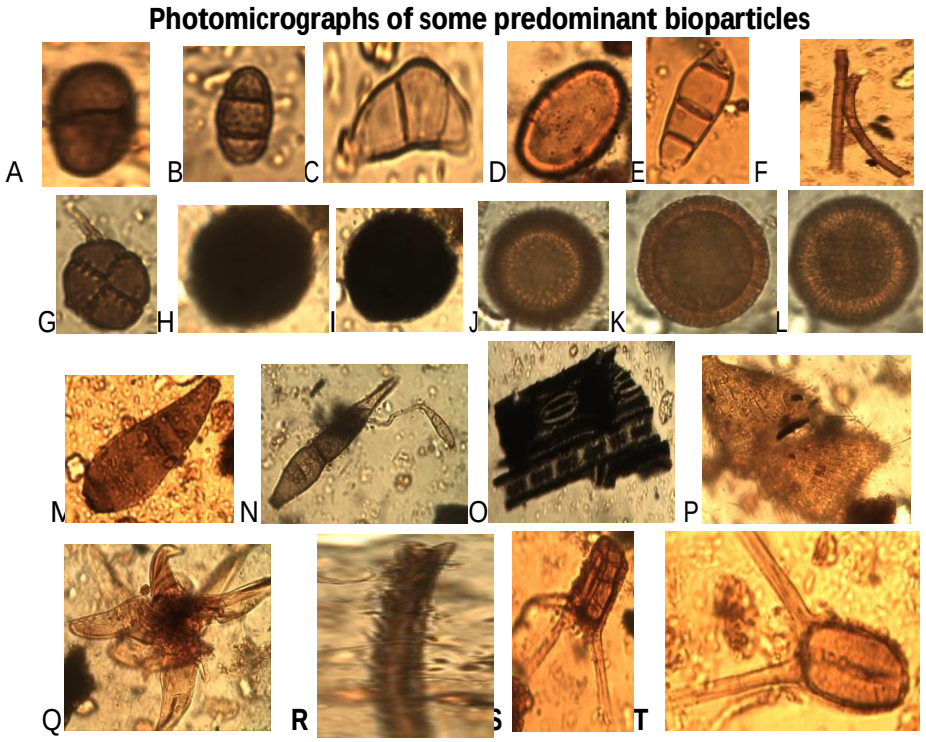

Figure 1. Fungal spores: *Botryodiplodiatheombromae*:- A; *Pithomyces*:- B; *Curvularia sp.*:- C; *Gliomastix*:- D; Septate fungal hyphae:-E; F. *Dictyoarthrinium*: G.: *Nigrospora*H-I; Exosporium: J-L; Dinoflagellate cysts: M,N. Burnt plant part: O. Insect part: P. Bryophytes leaves: Q. Insect feather: R. Tetraploa: S-T.

Findings agree favourably with the report of Agwu (2001) who demonstrated the application of 'Charred Graminae Cuticle' as a key identification of late Cenozoic climate changes in the Niger Delta. Although the results showed that the charred plant particles were trapped all through the study period from the atmosphere, higher quantities of these particles were trapped from the period of early to the late dry season (November-52 and May-11) whereas the highest values 1261 were trapped in December (Table 1). This could be due to annual bush fires that herald the onset of farming, activities of cattle herdsmen that want to stimulate fresh grass re-growth as well as people that engage in hunting expedition to flush out wild animals. Similar findings have also been reported by Agwu *et al*., (2004).

Analysis of variance for the various airborne bio particles showed that there was no significant difference ($P>0.05$) between the various taxa (groups).

The epidermis, cuticles and trichomes of burnt plant parts is recognizable and an increase in number in the atmosphere of the study area corresponds to an increase in the incidence of bush fire in the surrounding savanna vegetation. This factor could be used to monitor the frequency and intensity of indiscriminate bush fire.

The presence of fungal, bryophyte and pteridophyte spores, dinoflagellate cysts and diatom frustule in the atmosphere confirm the great influence of anthropogenic activities on the local vegetation. It is evident to say that several allergic reactions of the eyes resulting in symptoms such as sneezing, runny/ itchy nose as well as itchy and watering eyes prevalent in Anyigba environment is as a result of the abundance and prevalence of different species of these aerospora.

In conclusion, the results of this study has provide a standardized baseline information and data which could be used to monitor the frequency and intensity of indiscriminate bush fire in the surrounding savanna vegetation, provide adequate restoration and conservation measures for safety health and environmental sustainability and has also given a detailed information on the aerobiology of the Dekina Local Government Area of Kogi State, Nigeria at large.

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