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A Comparative Analytical Investigation of Airborne Palynomorphs within Kogi State University Teaching Hospital, Anyigba, Nigeria.

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ABSTRACT
Airborne palynomorphs of Kogi State University Teaching Hospital, Anyigba, Nigeria were acetolysed and analysed palynologically to determine the taxa of biological importance present in the atmosphere. The predominant and most frequently occurring palynomorphs types and spore genera include those of Burnt Plant Epidermis, Insects/ insect parts, trilete spores of pteridophytes, Dinoflagellate cysts, Johnson's grass smut, Charred Poaceae Cuticle, Pithomyces, Curvularia, and Botryodiplodia. The period of collection of palynomorphs (in months) does not affect the dispersal mechanism and rate of concentration of these palynomorphs in the atmosphere. The palynomorphs load of the entire study area varied quantitatively and qualitatively not only from month-to-month but also from site-to-site. The variations in the monthly palynomorphs counts (of families) and individual palynomorphs types at different sites suggest that the atmospheric concentration of palynomorphs is influenced not only by the meteorological factors, but is essentially a function of the frequency, density and abundance at a given locality. There were noticeable monthly fluctuations in the quantity of palynomorphs counted. However, there was no significant differences (P>0.05) in the total scores of palynomorphs trapped in the different months during the sampling period. The presence and relative abundance of these palynomorphs in the atmosphere affirms the great influence of anthropogenic activities on the local vegetation of the study environment. The study has provided useful baseline information and data which could be used predictively in forecasting season which is comparatively safe for those suffering from allergies.

Keywords: Airborne, Palynomorphs, Anyigba, Nigeria.

INTRODUCTION

The atmosphere is laden with many kinds of suspended particles of organic and inorganic origin having great diversity in size, shape, and density and from diverse source (Essien and Agwu, 2013). Diagenesis and fragmentation give rise to microscopic inorganic particles which are wafted into the atmosphere by wind. 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). Agashe (1994) in Essien and Agwu (2013) defines aeropalynology as 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). The term has further been extended to include the investigation of airborne materials of biological significance, embracing algae, protozoans, minute insects and insect parts, charred plant parts and in some cases gaseous pollutant and particles that exert specific biological effects.

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). Palynomorphs is the geological term used to describe a particle of size between five and five hundred micrometres, found in rock deposits (sedimentary rock) and composed of organic material such as chitin, pseudochitin and sporopollenin (Essien, 2014). Palynomorphs form a geological record of importance in determining the type of prehistoric life that existed at the time the sedimentary formation was laid down. As a result, these microfossils give important clues to the prevailing climatic conditions of the time. Airborne particles are a major cause of respiratory ailments of humans, causing allergies, asthma, and pathogenic infections of the respiratory tract. 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. 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 type and quantity of airborne palynomorphs at any point in time depends on a number of factors such as atmospheric humidity, rainfall, temperature, wind velocity and direction. In view of the fact that winds disseminate freshly released palynomorphs according to their seasonal fluctuating direction and strength, it is important to choose a time frame for maximum palynomorphs production and optimal wind action for such a study to be carried out for all seasons (Essien *et al*., 2013). These airborne palynomorphs can be trapped with specially designed equipment (Tauber, 1977).

The study is aimed at determining the abundance and distribution of airborne palynomorphs suspended in the atmosphere of the study environment. This would provide data for safety health and environmental appraisal related to the transport, dissemination and provenance of these airborne palynomorphs.

MATERIAL AND METHOD

Two locations were selected within Kogi State University Teaching Hospital, Anyigba, 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 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 April-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 100^0C (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).

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); Zillinsky (1983) and prepared slides of pollen samples in the Palynological Research Unit; Department of Biological Sciences, Kogi State University, Anyigba.

RESULTS AND DISCUSSIONS

Palynomorphs exhibits seasonal fluctuations in quantity as well as composition. Unspecified numbers and type of palynomorphs remain airborne after the flowering season. At the Kogi State University Teaching Hospital Site I sampling location, the total number of aerospora counted were 1020 fungal spores, 6 algal cysts, 8 diatoms, 11 dinoflagellate cysts, 70 pteridophytes (fern) spores, 324 burnt plant epidermis, 52 charred poaceae cuticle, 62 insects/ insect parts, and 217 johnson's grass smut (Table 1).

There were noticeable monthly fluctuations in the quantity of palynomorphs counted. However, there was no significant differences (P>0.05) in the total scores of palynomorphs trapped in the different months during the sampling period. There was an uneven distribution of palynomorphs throughout the study period in the samples studied. The predominant and most frequently occurring palynomorphs types and spore genera include those of *Pithomyces* (343), *Curvularia* (296), *Botryodiplodia* (297) and other palynomorphs: Burnt Plant Epidermis (324), Insects/ insect parts (62), trilete spores of pteridophytes (70), Dinoflagellate cysts (11), Johnson's grass smut (217) and Charred Poaceae Cuticle (52) also occur in almost all the months throughout the study period.

At the Kogi State University Teaching Hospital Site II sampling location, the total number of aerospora counted were 687 fungal spores, 4 algal cysts, 14 diatoms, 16 dinoflagellate cysts, 12 pteridophytes (fern) spores, 161 burnt plant epidermis, 61 charred poaceae cuticle, 48 insects/ insect parts, and 40 johnson's grass smut (Table 1).

There were noticeable monthly fluctuations in the quantity of palynomorphs counted. However, there was no significant differences (P>0.05) in the total scores of palynomorphs trapped in the different months during the sampling period (Table 1). There was an uneven distribution of palynomorphs throughout the study period in the samples studied. The predominant and most frequently occurring palynomorphs and spore genera include those of *Pithomyces* (206), *Curvularia* (205), *Stemphylum* (88), *Gliomastix* (33), *Teliospore* (40) and other palynomorphs: Burnt Plant Epidermis (161), Insects/ insect parts (48), and Charred Poaceae Cuticle (61) also occur in almost all the months throughout the study period.

Table 1 Summary of the Monthly Record of Atmospheric Palynomorphs Content across the study locations

PALYNOMORPHS TYPE	SITE I	SITE II	TOTAL
1.FUNGAL SPORES			
Alternaria	**-**	**6**	**6**
Botryodiplodia	**297**	**34**	**331**
Cerastosporium	**4**	**3**	**7**
Curvularia	**296**	**205**	**501**
Exosporium	**-**	**3**	**3**
Fungal hyphae	**-**	**2**	**2**
Gliomastix	**10**	**33**	**43**
Helminthosporium/ Drechslera	**5**	**5**	**10**
Neurospora	**11**	**35**	**46**
Nigrospora	**25**	**21**	**46**
Pithomyces	**343**	**206**	**549**
Stemphylum	**7**	**88**	**95**
Syncephalastrum	**5**	**3**	**8**
Teliospore	**15**	**40**	**55**
Tetraploa	**2**	**3**	**5**
SUB TOTAL	**1020**	**687**	**1707**
2. THALLOPHYTES:			
Algal cysts	**6**	**4**	**10**
Diatoms	**8**	**14**	**22**
Dinoflagellate cysts	**11**	**16**	**27**

SUB TOTAL	**25**	**34**	**59**
3. PTERIDOPHYTES:			
Pteris dentata	**-**	**8**	**8**
Pteris sp.	**-**	**4**	**4**
Trilete spores	**70**	**-**	**70**
SUB TOTAL	**70**	**12**	**82**
4. OTHER PALYNOMORPHS:			
Burnt plants epidermis	**324**	**161**	**485**
Charred poaceae cuticle	**52**	**61**	**113**
Insects/ insect parts	**62**	**48**	**110**
Johnson grass smut	**217**	**40**	**257**
SUB TOTAL	**655**	**310**	**965**

The rich occurrences and diversity of dinoflagellate cysts in the study 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 the study and has been interpreted to indicate transgressive and highstand regimes. The presence of arthropod particles (insects/ insect parts) in the atmosphere of the study environment 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. The occurrence and excessive increase in the relative abundance of burnt plant parts in the airborne palynomorphs of the study environment is an indication of annual bush fire and residual precipitation associated with the vegetation of the study area. 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. 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 region of Nigeria.

Much has been reported about the abundance and cosmopolitan nature of fungal spores and their associated allergenic reactions (runny nose, watery and itchy eye) and diseases of humans, domestic animals and plants. In fact, they constitute very serious danger to immune-compromised patients. Some of the fungal spores identified in this study have been reported by several authors to cause allergies such as rhinitis, pollinosis and exacerbation of asthmatic attack as well as pathogenic infections of the respiratory tract. Some of the spores identified here are among the invasive airborne fungal spores that have been implicated in nosocomial (hospital) infection of patients with solid organ transplants (Richardson and Ellis, 2000; Sanchez and Bush, 2001; Barnes and Rogers, 1989; Cashel *et al*., 2004). Such spore genera identified include *Alternaria, Drechslera/Helminthosporium, Nigrospora* and *Curvularia* among others.

The period of collection of palynomorphs (in months) does not affect the dispersal mechanism and rate of concentration of these palynomorphs in the atmosphere. The palynomorphs load of the entire study area varied quantitatively and qualitatively not only from month-to-month but also from site-to-site. The variations in the monthly palynomorphs counts (of families) and individual palynomorphs types at different sites suggest that the atmospheric concentration of palynomorphs is influenced not only by the meteorological factors, but is essentially a function of the frequency, density and abundance at a given locality.

CONCLUSION

The epidermis, cuticles and trichomes of burnt plant parts is recognizable and an increase in number in the atmosphere of the study environment 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.

The health and safety of the inhabitants of the study environment is at risk due to the presence and abundance of these palynomorphs in the atmosphere. These could trigger an outbreak of infections such as asthma, atopic dermatitis, runny nose, watery and itchy eye, pathogenic infections of the respiratory tract and allergic rhinitis among others. Most of the fungal pathogens encountered in the study show multiple and whole plant host ranges, while some others are saprophytic on agricultural produce. Their prevalence in the air is a reflection of their entrenchment and serious threats to agricultural crops, their produce as well as wild plants.

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