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The role of Airborne Pollen grains of some Angiosperms and Fungal Spores in Allergic and Pathogenic Infections in Anyigba, Kogi State, Nigeria

***Essien, Benjamin Christopher and Aina, Daniel Oluwagbemiga**

Department of Biological Sciences, Kogi State University, Anyigba, Nigeria.

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Airborne palynomorphs of Anyigba, Kogi State, Nigeria were analysed palynologically to determine the taxa of biological importance present in the atmosphere. The predominant palynomorphs were the allergic and offending pollen grains identified in this study which include those of Acanthaceae (*Justicia* sp.), Amaranthaceae/ Chenopodiaceae, Asteraceae tubiliflorae type (*Aspilia africana*), Bombacaceae (*Ceiba pentandra*), Caesalpinoideae (*Delonix* sp.), Cyperaceae, Mimosoideae (*Acacia* sp.), and Poaceae among others; and pathogenic spore genera include those of *Botryodiplodia* sp., *Curvularia* sp., *Gliomastix* sp., *Helminthosporium*/*Drechslera* sp., *Neurospora* sp., *Nigrospora* sp., *Pithomyces* sp., *Teliospore* and *Stemphylum* sp. Several allergic reactions of the eyes resulting in symptoms such as sneezing, runny/ itchy nose as well as itchy and watering eyes prevalent in the study environment recently is as a result of the abundance and prevalence of different species of these aerospora. The presence of fungal spores in the atmosphere may influence anthropogenic activities on the local vegetation. Analysis of variance for the various airborne pollen and fungal spores showed that there was no significant difference (P>0.05) between the various groups. This study would provide a good template that could be used to monitor the frequency and intensity of pollen and fungal allergies and various disease conditions of plants, animals and man in the surrounding environment, and provide adequate restoration and conservation measures for safety health and environmental sustainability.

KEYWORDS: Airborne, Allergy, Fungal spores, Nigeria, Palynomorphs, Pathogenic, Pollen.

INTRODUCTION

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). Airborne fungal spores are also important agent of plant disease, and the means for dissemination of many common saprotrophic (saprophytic) fungi. Pollen grains induce allergic responses in susceptible individuals. Allergic pollen grains belong to three broad categories of plants: grasses, weeds and trees. Allergy to pollen grains is called pollinosis (Essien, 2014; Essien et al., 2013). Aerobiology is a branch of science that studies organic particles such as bacteria, fungal spores, very small insect and pollen which are passively transported by air (Spieksman, 1991). Some of these spores are explosively released during the night, and dispersal problems are therefore different from those concerning pollen grains. One of the

*Corresponding authors' Email: benjaminessien8@gmail.com

main fields of aerobiology has traditionally been to measure and report quantities of airborne pollen 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 (Njokuocha and Ukeje, 2006). Fungal spores are of particular interest because of their association with plant diseases and pollinosis in man. 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). Owing to their allergic effects and very frequent occurrence, some fungal spores play an important role in medical aerobiology (Barnett and Hunter, 1998).

Allergy is an altered and accelerated reaction of a person to a second or subsequent exposure to substances to which he/she has been sensitized during the first exposure which could results to a condition in which the body produces an abnormal immune response to certain antigens which include dust, pollen, certain food and drugs, or fur (Singh and Singh, 1994). Generally pollen that causes allergies are those of anemophilous plants. Such plants produced large quantities of light weight pollen with psilate (pollen wall surface with completely smooth sculpturing) exine which can be carried for great distances and are easily inhaled, bringing them into contact with the sensitive nasal passages (Singh and Rawat, 2000). A characteristic feature of pollen allergy is its seasonal occurrence associated with the prevalence of pollen of these particular species in the atmosphere. It has been reported by Burge and Rogers (2008) that air-borne pollen grains and spores widely cause various allergic complaints such as hay fever, eczema and asthma.

In hay fever and asthma responses, pollen grains enters the nose and lands on the mucous membrane of the upper and/or lower respiratory tract. Pollen grains get hydrated by the mucus secretion and release pollen allergens which penetrate the mucous tissues (Foster and Clark, 2001).

The quantity and quality of palynomorphs, especially pollen grains and spores in the air at any given time depend largely on the plant and fungi producing them, the abundance of the plant communities, the nature of palynomorphs, the flowering or season of reproduction and the meteorological factors such as rainfall, humidity, temperature, wind speed and wind direction (Agwu, 2001). Pollen dispersal is facilitated by dry weather and high wind velocity. Though other airborne substances may also lead to allergic reactions, the toxins of pollen grains are of major importance. Allergic asthma is the disease of airways and the allergens have to reach the lower respiratory tract to trigger allergic asthma. Allergens containing microscopic particles released from bursting of pollen of grasses have been reported to occur in the atmosphere (Suphioglu et al., 1992). They provide mechanism by which pollen allergens may reach the lower respiratory tract (bronchi and lungs) and cause asthma (Ong et al., 1995). 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). 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).

A continual check on the pollen content of the air is essential, partly in order to establish the general role of pollen incidence, finding areas and periods which are comparatively safe for allergic persons; partly in order to give forecast of the pollen incidence for the following day or days. The main aim of this study was to identify the different airborne pollen and fungal spore genera of biological importance circulating in the atmosphere of Anyigba, 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 (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. 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 rainy seasons' samples) for one year (2012). The 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). 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).

The palynomorphs were analysed palynologically and 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 (1995), and Zillinsky (1983).

RESULTS

A total of 5731 pollen grains and 9491 fungal spores were encountered in the study (Table 1). The large quantity of fungal spore occurrence in the atmosphere could be associated with the large tracts of maize farms as well as other infected crop plants in and around the study environment. 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. There were noticeable monthly fluctuations in the quantity of pollen grains and other palynomorphs counted. The most frequently occurring pollen types and spore genera include those of angiospermic families like Poaceae, *Amaranthaceae*/ *Chenopodiaceae*, *Asteraceae tubiliflorae* type (*Aspilia africana*), *Alternaria* sp., *Curvularia* sp., *Dreschelia* sp., *Neurospora* sp., *Pithomyces* sp., and *Stemphylum* sp. also occur in almost all the months throughout the study period.

DISCUSSIONS

Many airborne pollen grains are potent biopollutant responsible for human respiratory and skin itching allergies. They cause or exacerbate a number of allergic manifestations such as bronchial asthma, naso-bronchial allergy, conjunctivitis, contact dermatitis, and pollinosis. Although this study did not extend to clinical immunological or sensitivity tests, some of the pollen grains identified in this work have been proven to be perennial or seasonal causes of allergy (Mishra et al., 2002). Such offending pollen grains identified in this study include those of *Acacia* sp. (Mimosoideae), Amaranthaceae/ Chenopodiaceae, Asteraceae tubiliflorae type, *Ceiba pentandra,* Cyperaceae, *Delonix sp., Justicia* sp., and Poaceae among others. 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. Results of this study agrees favourably with the report of Cashel et al., (2004) who opined that these fungal spores cause allergies such as rhinitis, pollinosis and exacerbation of asthmatic attack as well as pathogenic infections of the respiratory tract. Some of these spores genera identified in this study are among the invasive airborne fungal spores that have been implicated in nosocomial (hospital) infection of patients with solid organ transplants. Such spore genera identified include those of *Alternaria sp., Drechslera sp., Nigrospora sp.* and *Curvularia sp.* among others.

Pathologically, most of the fungi species identified in this study have also been associated with diseases of many agricultural crops and wild plants in Nsukka (Njokuocha, 2006). Among the diseases are loose smut of maize, leaf blight and spots, damping-off and scab caused by species of *Alternaria sp.*, *Dreschelia sp.,* and cassava blight (*Alternaria sp.*) among others. Most of these fungal

Table 1. Allergic and Pathogenic Airborne Pollen grains and Spores Spectrum.

Airborne Pollen/ Spores Genera	MAR.	APR.	MAY	JUN.	JUL.	AUG.- OCT.	NOV.	DEC.	TOTAL
Asteraceae *tubiliflorae* type	37	34	52	60	45	28	41	65	362
Amaranthaceae /Chenopodiaceae	-	56	53	8	5	15	26	33	196
Acacia **sp.** (Mimosoideae)	7	14	3	-	-	-	8	3	35
Ceiba pentandra (Bombacaceae)	11	17	4	-	-	-	-	7	39
Cyperaceae	17	10	15	-	-	-	3	7	52
Delonix **sp.** (Caesalpinoideae)	8	10	-	-	-	-	1	2	21
Justicia **sp.** (Acanthaceae)	21	19	6	-	-	-	5	11	62
Poaceae	90	315	1358	985	539	336	745	596	4964
TOTAL POLLEN GRAINS	191	475	1491	1053	589	379	829	724	5731
Alternaria sp.	27	75	20	11	7	5	5	92	242
Curvularia sp.	65	337	70	41	-	11	35	198	757
Dreschelia sp.	42	93	3	18	3	-	21	16	196
Neurospora sp.	914	146	427	619	611	343	206	475	3741
Pithomyces sp.	2	3	5	11	4	5	3	21	54
Stemphylum sp.	-	54	38	27	-	7	88	30	244
Syncephalastrum sp.	22	11	7	4	-	-	-	-	44
Teliospore	-	27	27	-	-	15	79	82	230
TOTAL FUNGAL SPORES	1745	1307	1113	1252	809	784	724	1757	9491

pathogens show multiple and whole plant host ranges, while some others are saprophytic on agricultural produce. Their prevalence in the atmosphere of the study environment is a reflection of their entrenchment and serious threats to agricultural crops, their produce as well as wild plants. The presence of these fungal spores in the atmosphere may influence anthropogenic activities on the local vegetation of the study environment. Analysis of variance for the various airborne pollen and spores shows that there was no statistical significant difference ($P>0.05$) between the various taxa.

Results of this study agree favourably with the work of Singh and Babu (1981) who opined that 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 behaviour at a given locality. 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.

CONCLUSION

The health and safety of the inhabitants of the study environment is at risk due to the presence and abundance of fungal spores in association with pollen of grasses and weeds in the atmosphere. These could trigger an outbreak of pollinosis, asthma, atopic dermatitis, pathogenic infections of the respiratory tract and allergic rhinitis among others.

The study has provide useful baseline information and data which could be used predictively in forecasting season which is comparatively safe for those suffering from allergies such as hay fever (pollinosis) and to monitor the frequency and intensity of pollen and fungal allergies and various disease conditions of plants, animals and man in the surrounding catchment environment, and provide adequate restoration and conservation measures for safety health and environmental sustainability.

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