Palynotaxa and Parasitic Loads of Nigerian Currency: Potential Sources of Microbial Transmittance

Ezikanyi D. N.[1], Ani O.C.[2], Nnamani C.V.[3], Nwankwo O. E.[4]

[1,4]Department of Applied Biology, Ebonyi State University, Abakaliki, Ebonyi State, Nigeria
[2]Parasitological Unit of Department of Applied Biology, Ebonyi State University, Abakaliki, Ebonyi State, Nigeria
[3]Laboratory of Plant Taxonomy/Biosystematics, Palynological and Bioresources Management Unit, Department of Applied Biology, Ebonyi State University Abakaliki, Nigeria

Summary Statement—*This study indicated that the currency- associated palynotaxa and parasitic community is diverse and are potential health hazard. The major sources of parasitic contaminants was from fecal sources and indicated high unhygienic condition among the currency users.*

Abstract— *Currency notes are handled by a large number of people under a variety of personal and environmental conditions. A total of ninety six samples of one hundred naira denomination of Nigerian notes were procured from seven Local Government Areas (LGA) of Ebonyi State, Nigeria. The aim of the study was to determine the palynotaxa and parasitic load prevalent on currency notes. The leachates of currency notes were obtained and subjected to acetolysis and examined microscopically. Twenty six fungal spores type were recorded and were highly dominated by spores of Libertelli spp., Botrytis spp. and Spadicoides spp. Pollen achieved 54 % of the total bio-particles, whereas fungal spores and parasitic worms achieved 35.2 % and 10.60 %, respectively. The presence and relative abundance of these palynotaxa and parasites in currency notes affirms their propensity to spread vectors of diseases.*

Keywords— Currency notes, Pollen, Fungal spores, health, Ebonyi State.

I. INTRODUCTION

Palynotaxa are organic microfossils between 5 and 500 micrometres in size and include both plant and animal structures that are microscopic in size and composed of compounds that are highly resistant to most forms of decay other than oxidation (Erdtman, 1969). Many palynotaxa species require specific conditions to survive, making them useful indicators of global environmental conditions and changes (Niklasson *et al.*, 2002). These types of palynotaxa include spores, pollen, dinoflagelletes, arcritarchs etc. (Erdtman, 1969). Among palynotaxa, pollen and fungal spores are more ubiquitous and widely distributed in time and space than any other representatives of living matter (Shahali *et al*., 2012)

Pollen and fungal spores have been reported to be present in variety of environment and over a wide temperature range in both indoors and outdoors environment (Nnamani and Onu, 2014, Osayi *et al*., 2012, Horner, 2000). When pollen and fungal spores are dispersed in ambient air, they settle on different surfaces which include vehicles, water bodies, ground surface, on human skin and other surfaces. They have great aerodynamic properties which permit their wide dispersal thereby increasing dispersal distance (Schwendemann *et al*., 2007)

Nigerian currency has wide surface area to volume ratio and then offers a large surface area for organisms and organic debris to collect (Alemu, 2014) and as such could provide a favourable surface for adhesion especially the non-polymer notes. In Nigeria, the naira notes in circulation are abused by squeezing, stapling, torn cello taped, ripped, faded and writing on them. The contamination of the naira notes could be from several sources. It could be during storage, usage handling or production (Matur *et al*., 2008). Daily transactions have made the naira notes to pass through many hands as money is used as a medium of exchange for goods and services, settlement of debts and for payment in economic activities (Beg and Fisher, 1997). Modern banknotes are made from a special blend of cotton, linen, other textile fiber and animal gelatin for the surface coating of banknotes with small segments of fiber. The cotton/ linen/fiber combination of banknotes produce a strong bond and do not pull apart, unlike the fibers of ordinary paper

Studies from around the world have reported high rates of microbial contamination of currency note in circulation (Ayandele and Adeniyi, 2011). Although every location contained endemic organism, the microorganisms most commonly isolated on money include members of the family; *Enterobacteriacea, Mycobacterium, Tuberculosis,*

Vibrio cholerae, *Bacillus* sp., *Staphylococcus* sp. *Micrococcus* sp. and *Corynebactrium* sp. (Alemu, 2014). Potentially dangerous bacterial agents isolated from currency note include *Streptococcus* and *Staphylococcus* that have developed resistance to conventional antibiotics (Alemu, 2014). The present work however studies the palynotaxa and parastic loads of Nigerian currency procured from seven local Government Area of Ebonyi State.

II. MATERIALS AND METHODS

Sample Collection

Seventy two (72) samples of one hundred naira denomination Nigeria notes were collected for this study. They were procured from seven local Government Areas of Ebonyi State namely; Abakaliki, Ebonyi, Izzi, Ohaukwu , Ezza North, Ezza South and Onicha Local Government Areas. Control samples were obtained from Central bank of Nigeria, Abakaliki, Ebonyi State branch. The study areas were selected out of thirteen Local Government Areas (Figure 1) by randomization to avoid bias. Three samples of one hundred naira denominations were randomly exchanged from traders in three different places in each local Government Area. All naira notes were collected using hand gloves into labeled sterile polythene bags and conveyed to the Department of Applied Biology, Ebonyi State University for analysis. Each note was washed with 100 ml of distilled water, the leachates were centrifuged at 2500 revolution per minutes (RPM) and the sediments recovered.

Acetolysis

The recovered sediment were acetolyed after the acetolysis mixture was prepared with nine parts of acetic anhydride to one part of sulphuric acid (Agwu and Akanbi, 1985). Five ml of the mixture was measured into each sample in a centrifuge tubes, the centrifuge tubes containing the residues and acetolysis mixture were boiled in a water bath at 100 ^{o}C for 10 minutes. This process was followed by centrifugation and decantation to recover the sediments; the recovered sediments were washed once with glacial acetic acid and then three times with distilled water. Each wash was followed by centrifugation and decantation. The sediments were poured into sterile vial bottle and stored with a drop of glycerol. Temporary slides were prepared and examined microscopically using light Olympus Microscope (LM) fitted with 650 IS Motican Digital Camera 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 by Agwu and Akanbi (1985), Y'bert (1979).

The data obtained were analyzed using the SPSS statistical package version 20 (SPSS Inc. Chicago, Illinois USA). Descriptive and frequency statistics were generated to examine the prevalent of palynotaxa and parasites recorded in the six Local Government Areas

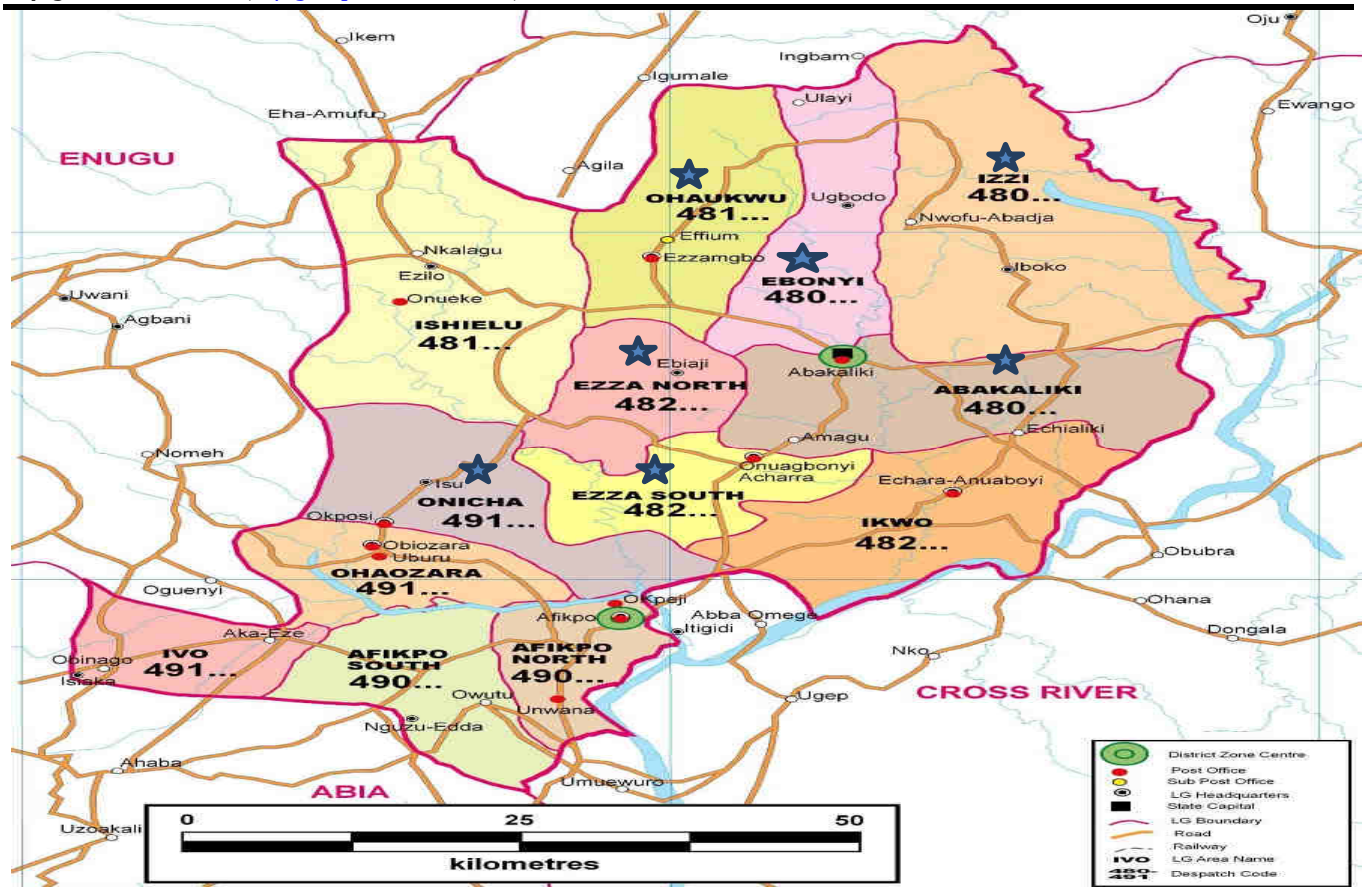

Fig. 1: Map of Ebonyi State showing the sampled Local Government Areas

Source: www.ebonyionline.com

III. RESULT

A total of 264 palynotaxa and parasitic loads were recorded from the samples, palynotaxa achieved 236 (89.39 %), out of which pollen accounted for 143 (54.17 %) and fungal spores were 93 (35.22 %) . The ratio of palynomorphs to microbial was 8 : 1 (Figure 2) . The parasitic load accounted for 28 (10.60 %) and were more preponderant in Onicha sample. *Irvingia wombolu* pollen grains were the most dominant and were present in Izzi and Ohaukwu samples and other pollen were sparsely distributed (Table 1). In Abakaliki samples, Pollen from *Mussaenda erythrophyllasilum* were higher than others. *Terminalia* sp., and Poaceae were higher in Ebonyi samples. Pollen from *Khaya senegalensis* were higher than other pollen in Ezza North sample.

Mycological communities were diverse, 26 fungal spores morphotypes were recorded, most of them were sparsely distributed among the samples from the seven local government Areas. Spores of *Libertella* sp. dominated samples from Ezza North and Onisha Local Government Areas and achieved 10.75 % and 21.50 % respectively of the total fungal spores recorded. Ohaukwu samples had the highest record of fungal spores morphotype, followed by Ebonyi, Ezza South, Izzi, Abakaliki, Ezza North and Onicha in decreasing order of dominance (Figure 2). There was no record of any palynotaxa nor parasite on the curreny notes procured from Central bank of Nigeria, Abakaliki branch , Ebonyi State. Spores from Nigrospora sp. were higher than other fungal spores in Abakaliki samples (Table1;Plate 1). Spores of Spadicoides were also higher than other fungal spores in Ohaukwu samples. There were parasites on notes procured from Ezza North and Onicha Local Government Areas. The parasitic load on Onicha notes differed significantly from notes obtained from other local Government Areas(Table 2).

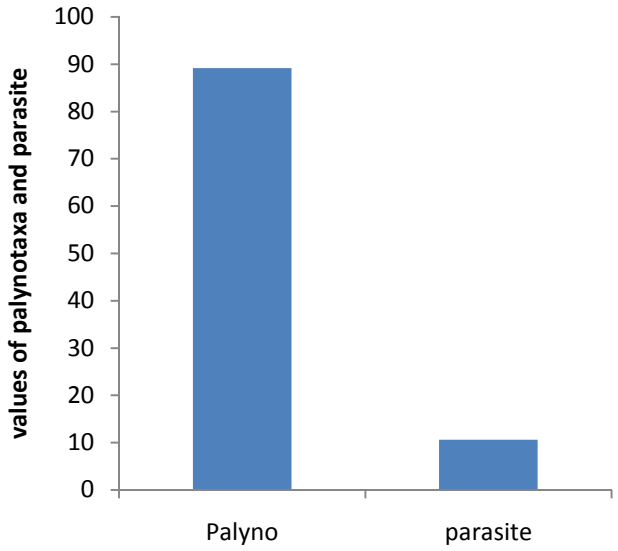

Fig.2: Percentage contributions of Palynotaxa and microbial load in currency
Palyno- palynotaxa

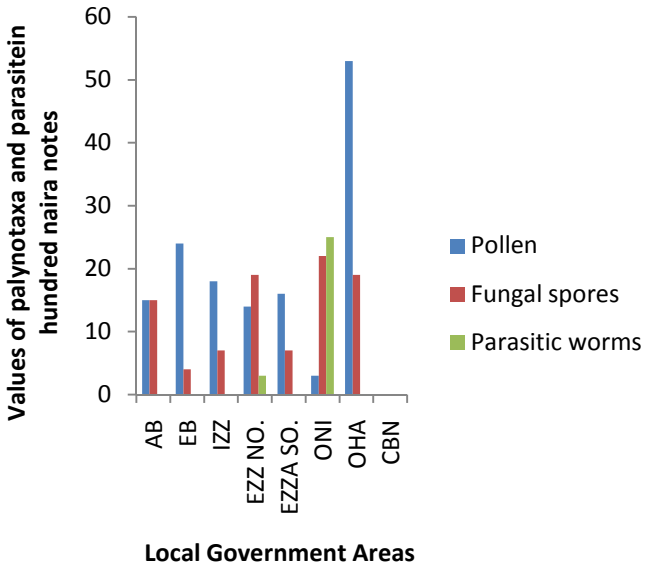

Fig.3: Values of palynotaxa and parasite in hundred naira notes

Table 1: Palynotaxa in the Seven Local Government Areas of Ebonyi State, Nigeria

L GA / PALYNOMORPHS Pollen from Plant taxa	ABAKALIKI LGA	EBONYI LGA	IZZI LGA	EZZA NORTH LGA	EZZA SOUTH LGA	ONICHA LGA	OHAUKWU LGA	CBN
Phoenix reclinata Jacq	o, o, o	o, o, o	o, o, o	1, o, o	o, o, 0	o, 1, 1	o, o, o	o, o, o
Sporobolus pyramidalis P. Beauv	1, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Khaya senegalensis (Desr.) A.Juss	1, o, o	o, o, o	o, o, o	o, o, 6	o, o, o	o, o, o	o, o, o	o, o, o
Chrysophyllum albedium L.	1, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Garcinia afzelii Engl.	o, o, 1	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Elaeis guineensis Jacq	o, o, 2	o, 2, o	o, o, o	o, o, o	o, 3, o	o, o, o	2, o, 1	o, o, o
Terminalia spp.	o, o, 1	5, o, o	o, o, 1	o, o, o	1, o, o	o, o, o	o, o, o	o, o, o
Prosopis africana (Guill., Perrott and Rich)	1, o, o	1, o, o	o, 1, 2	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Nauclea latifolia Smith	o, o, o	3, o, o	o, o, o	o, o, o	1, o, o	o, o, o	o, o, o	o, o, o
Amaranthaceae Types	o, o, o	o, 3, o	o, o, o	1, o, o	o, o, o	o, o, o	o, o, o	o, o, o

Poaceae	1, o, o	o, 5, 2	o, o, o	o, o, o	o, o, 2	o, o, o	o, o, o	o, o, o
Solanum melongena L.	o, o, o	o, 1, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Hydrophyceae	o, o, o	o, o, 1	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Hexalolus rus	o, o, o	o, o, 1	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Carica papaya L.	o, o, o	o, o, o	3, o, 1	o, o, o	o, 2, o	o, o, o	o, o, o	o, o, o
Syzygium guineense var Engr.	o, o, o	o, o, o	o, 2, o	1, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Mussaenda erythrophyllasilum Schumach. & Thonn.	o, 4, o	o, o, o	o, 1, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Cleistopholis patens Engl.	o, o, o	o, o, o	o, 1, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Parkia clappertoniana keay	o, o, o	o, o, o	1, o, 1	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Irvingia wombolu	o, o, o	o, o, o	o, o, 4	o, o, o	o, o, o	o, o, o	1, 48, o	o, o, o
Piptaadeniastrum africanum (Hook.F) Brenan (Dadema)	o, o, o	o, o, o	o, o, o	o, 1, o	o, o, o	o, o, o	o, o, o	o, o, o
Lannea welwitschii (Hiern) Engl.	o, o, o	o, o, o	o, o, o	o, 3, o	o, o, o	o, o, o	o, o, o	o, o, o
Morus mesozygia Stapf.	o, o, o	o, o, o	o, o, o	o, 1, o	o, o, o	1, o, o	o, 1, o	o, o, o
Sterculia sp.	o, o, o	o, o, o	o, o, o	o, o, o	1, o, 3	o, o, o	o, o, o	o, o, o
Manihot utilissima Mull. Arg	o, o, o	o, 1, o	o, o, o	o, o, o	1, 1, 1	o, o, o	o, o, o	o, o, o
Allophyllus africanus P. Beauv	1, 1, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Sub total	**6, 5, 4**	**9 11, 4**	**4, 5, 9**	**3, 5, 6**	**4, 6, 6**	**1, 1, 1**	**3, 49, 1**	**o, o, o**
Fungal spores								
Curvularia sp.	2, 1, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Spadicoides sp.	1, o, o	o, o, o	o, 2, o	o, o, o	o, 1, o	o, o, o	11, 1, 1	o, o, o
Nigrospora sp.	2, 2, 1	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, 1, o	o, o, o
Gonatophragnium sp.	o, o, 3	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Ampulliferina sp.	o, o, o	1, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Helminthosporium sp.	o, o, o	o, o, 1	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Aspergillus sp.	o, o, o	o, o, o	1, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Gyrothrix sp.	o, o, o	o, o,	1, o,	o, o,	o, o, o	o, o,	o, o, o	o, o,

		o	o	o		o		o
Penicillium sp.	o, o, o	o, o, o	o, 1, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Metarrhizium sp.	o, o, o	o, o, o	o, 1, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Fusarium sp.	o, o, o	o, o, o	o, 1, o	o, o, o	o, o, 1	o, o, o	o, o, o	o, o, o
Botrytis sp.	o, o, o	o, o, o	o, o, o	3, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Articulospora sp.	o, o, o	o, o, o	o, o, o	2, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Libertella sp.	o, o, o	o, o, o	o, o, o	2, 8, o	o, 1, o	4, o, 16	o, o, o	o, o, o
Circinotrichum sp.	o, o, o	o, o, o	o, o, o	o, 2, o	o, o, o	o, o, o	o, o, o	o, o, o
Calcirisporium sp.	o, o, o	o, o, o	o, o, o	o, o, 2	o, o, o	o, o, o	o, o, o	o, o, o
Spiropes sp.	o, o, o	2, o, o	o, o, o	o, o, o	1, 2, o	o, o, o	o, o, o	o, o, o
Bactridium sp.	o, o, o	o, o, o	o, o, o	o, o, o	1, o, o	o, o, o	o, o, o	o, o, o
Myrothecium sp.	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	1, o, o	o, o, o
ovulariopsis sp.	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	1, o, 1	o, o, o
Candida sp.	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, 2, o	o, o, o
Cryptosporium sp.	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	1, o, o	o, o, o	o, o, o
Anguillospora sp.	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, 1, o	o, o, o	o, o, o
Tetraploa sp.	o, 1, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Cladosporium sp.	o, 1, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Puccinia sp.	o, 1, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o
Sub total	**5, 6, 4**	**3, o, 1**	**2, 5, o**	**7, 10, 2**	**2, 4, 1**	**5, 1, 16**	**13, 4, 2**	**o, o, o**
Parasitic worms								
Strongyloides steroralis	o, o, o	o, o, o	o, o, o	o, o, 3	o, o, o	o, 4, 3	o, o, o	o, o, o
Ascaris sp.	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	12, o, o	o, o, o	o, o, o
Ancylostoma sp.	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	o, 4, o	o, o, o	o, o, o
Enterobium sp.	o, o, o	o, o, o	o, o, o	o, o, o	o, o, o	2, o, o	o, o, o	o, o, o
Sub total	**o o o**	**o, o, o**	**o, o, o**	**o, o, 3**	**o, o, o**	**14, 8, 3**	**o, o, o**	**o, o, o**
Grand Total	**11, 11, 8**	**12, 11, 5**	**6, 1o, 9**	**10, 15, 9**	**6, 10, 7**	**20 10, 20**	**16, 53, 3**	**o, o, o**

	= 30	**= 28**	**= 25**	**= 36**	**= 23**	**= 50**	**= 72**	**= o**

LGA- Local Government Area
CBN- Central Bank of Nigeria
o- no record

Table 2: Palynotaxa and parasite prevalent on naira hundrend naira note procured from six Local Government of Ebonyi State,Nigeria

Local Government Areas	Pollen	Fungal spores	Parasite
Abakaliki	5.00±0.58	5.00±0.57	0.00±0.00
Ebonyi	8.00±2.08	1.33±1.52	0.00±0.00
Izzi	6.00±1.52	2.33±1.45	0.00±0.00
Ezza North	4.66±0.88	6.33±2.33	1.00±1.00
Ezza South	5.33±0.66	2.33±0.88	0.00±0.00
Onicha	1.00±0.00	7.33±4.48	5.00±1.53*
Ohaukwu	17.67±15.67	76.33±3.38	0.00±0.00
CBN	0.00±0.00	0.00±0.00	0.00±0.00

Values are expressed as means ± S.E.M. for n =5
*Significant at P<0.05

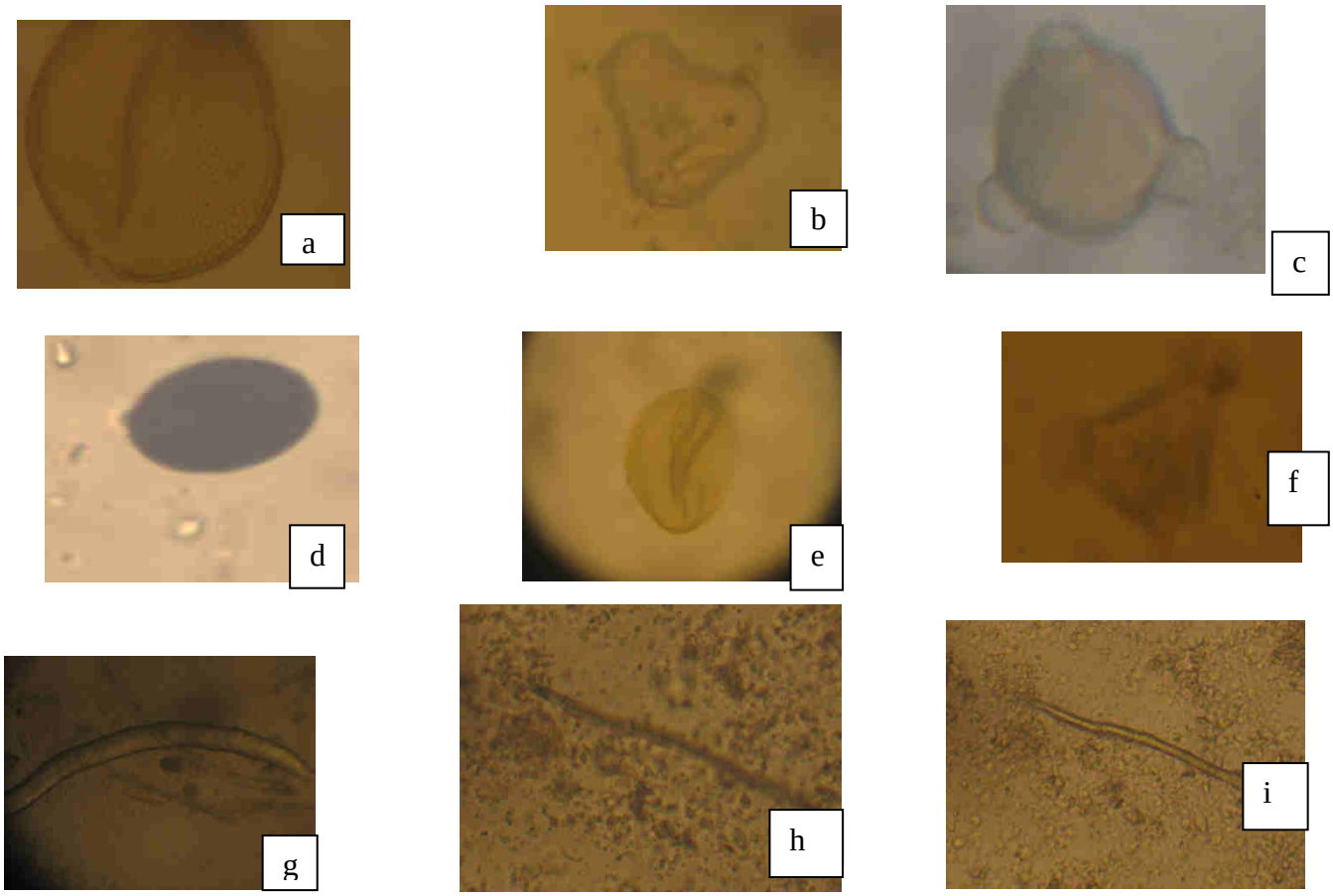

Fig.4: Photomicrographs of some palynotaxa and parasite. a- Pheonix reclinata (pollen). b- Elaeis guineensis (pollen). c- Olax sp. (pollen) d- Nigrospora sp.(fungal spore). E.- Cyperus sp. (pollen) f.- Parinaria sp.(pollen) g.- Ancytostoma sp. (parasitic worm) h.- Enterobium sp. (parasitic worm) i- Ascaris sp.(parasitic worm)

IV. DISCUSSION

The identified pollen reflected the taxa of Mosaic of the Lowland Rainforest and Derived Savanna, which is typical of Ebonyi environs as reported by Nnamani and Uguru, 2013, Osayi *et al*., 2012). This work establishes for the first time the possible use of currency note in simulating the vegetation of an area. The pollen released by *Irvingia wombolu* were more preponderance in Ohaukwu sample and were also recorded higher than other pollen, their dominance could be attributed to the correlation of their flowering period with the period of sampling (September).

The large surface area to volume ratio of the currency notes offered pollen and fungal spores a favourable adhesive surface for them to impact on. Though palynomorphs and parasite are ubiquitous in outdoors environment and could spread on currency notes through trade, travel and vectors to geographical areas since they occur in diverse, complex and interdependent communities. This results are in conformity with the reports by Ayandele and Adeniyi, (2011).who showed that paper currency serves as an ideal breeding ground for microorganisms for several reasons. First, the paper bills offer a large surface area for organisms and organic debris to be collected Secondly, folds and/or deliberate depressions or projections specifically engineered into the notes serve as settling sites for both organisms and debris (Lamichhane *et al.,* 2009). Lastly, currency notes weave their way through the population for many years. Pradeep *et al.,* (2012) indicated that the age and denomination of notes have a direct correlation with the contamination and the presence of organism in them.

Assemblage of Mycological Communities

Twenty - six fungal spores type were recorded, Ebonyi, Izzi and Ezza South Local Government Areas had the least fungal spores load (Table 1). The spores of *Libertella* sp. and *Spadicoides* sp were more preponderance in Onicha and Ohaukwu samples respectively. This study indicated that the currency- associated fungal community is diverse, concentrations of fungal spores observed varied among the local Government Areas. The study brought to lime light, that the texture of one hundred naira denomination of Nigerian notes provide an enabling environment that harbor diverse mycological communities. The high diversity of fungal spores on a dirty note shows that they have passed through many hands unlike in the control currency that had no palynotaxa nor parasite. In contrast to microbial studies of soil or air environments, fewer studies have been devoted to currency borne - fungal spores..

Unlike the other samples, Onicha and Ezza North samples revealed presence of parasitic worms such as *Ascaris* sp., *Strongyloides stercoralis, Ancylostoma* sp. and *Enterobium* sp. These worms pose a health threat to human. The presence of *Strongyloides stercoralis* in Onicha samples could indicate contamination of the currency notes with faeces or improper of washing of hand after defecation by users . *S. stercoralis* was first revealed in the faeces of French soldiers in 1876 (Vadlamudi *et al*., 2006). The life cycle and pathogenesis were not discovered until the early 1900s. *Strongyloides stercoralis*, also called threadworms, is a nematode helminth parasite that causes strongyloidiasis (Fardet *et al*.,2006). *S stercoralis* is most prevalent in warm climates but has the ability to survive in colder climates. It is endemic in Africa, South and Southeast Asia, South America, rural parts of Italy, Papua New Guinea, and the Pacific Islands such as Fiji. (Vadlamudi *et al*., 2006). There are an estimated 100 million to 200 million people infected with *S stercoralis* residing in 70 different countries (Vadlamudi *et al*., 2006; Bianchi *et al*., 2006). The true prevalence of an *S. stercoralis* infection is underestimated because majority of the cases are sub-clinical (Fardet *et al*.,2006). There are 53 species of the organism, and the most common infection is due to the species *S stercoralis*.

The presence of *Ascaris* sp. is Onicha sample also indicated fecal contamination. It causes one of the most common infections that affects 11 billion people worldwide. *Enterobius* sp. is often referred to as pinworm and is an intestinal nematode which commonly infects children throughout the world. Transmission of *Enterobius* sp. eggs occurs through the fecal-oral route, with eggs being directly inoculated from the fingers into the mouth. The eggs are infective shortly after being laid, making autoinfection a common route of intestinal infection. Following ingestion, the embryonated eggs hatch in the small intestine and develop into adult worms that reside in the cecum, appendix, colon, and rectum (Babady *et al*., 2011). A case of pelvic inflammatory disease in a sexually non-active 13 year old girl has been described, with evidence of pinworms as the cause (Tandan *et al*., 2002). Gastrointestinal infection due to Enterobius occurs worldwide and is considered to be the most common helminth infection. The simple presence of *E. vermicularis* in the appendix usually produces symptoms of acute appendicitis. The association of this parasitic infestation with acute appendicitis varies from 0.2 %–41.8 % worldwide.

The higher prevalence of these worms in Ezza North and Onicha samples could pose a health threat to individuals as the currencies circulate, these contamination could be

introduced by individual with unhygienic habits such as improper hand washing after using toilets, removal of children faeces and storage of paper notes on dirty surfaces. It therefore becomes very worrisome when Nigerian tongue-wet their fingers when counting money thereby inoculating these parasite laden in currency into the body system and when women pocket their naira note into their braziers for safety. These parasite contaminated notes will also act as a vehicle delivering pathogen to contaminate hands of the next user. Dada *et al*. (1979) stated that the source of contamination of naira notes include poor handling such as spraying during ceremonies and dirty hands contaminated with human and animal faecal matters. Individuals from almost every socio-economic background routinely hold and transfer paper currency. Any object that can spread communicable diseases throughout a diverse population should be considered a risk to public health. Therefore, currency has an important role in the transmission of pathogenic microorganisms and presents a moderate risk to public health (Lamichhane *et al*., 2009).

V. CONCLUSION

The results showed that hundred naira currency notes harbor lots of palynotaxa and microbes and this may serve as a good source of infection. The level of contamination with palynomorphs and microbes varied among the local Government Areas. However results indicated possible fecal contamination source of currency from Onicha Local Government Area. Control samples from Central Bank of Nigeria were devoid of these organisms which indicated that their presence on currency was as a result of hand –to-hand transfer.

Many of the identified fungi are potentially pathogenic or common human pathogens, even those not commonly associated with diseases in healthy host can cause clinical significant infection in immune-compromised patients. Personal hygiene in handling currency is recommended to reduce the risk of infection.

REFERENCES

[1] Agwu, C.O.C. and Akanbi T. O. (1985). A palynological study of honey from four vegetation zones of Nigeria. *Pollen et Spores* **27**, 335-348.

[2] Alemu, A.(2012). Microbial contamination of currency notes and coinsin circulation: A potential public health Hazard. Biomedicine and Biotechnology 2(3) 46-53

[3] Ayandele, A.A. and Adeniyi, S.A. (2011). Prevalence and antimicrobial resistance pattern of microorganism isolated from Naira notes in Nigeria. *Journal of Research in Biology* 587-593.

[4] Babady, N.E., Awender, E., Geller,R., Miller, T., Scheetz,G., Arguello,H., . Weisenberg, S.A. and Pritt, B. (2011).*Enterobius vermicularis* in a 14-Year-Old Girl's Eye. *Journal of Microbiology* 49**(12)**: 4369-4370

[5] Beg, M.O. and Fisher, (1997). Major means of exchange in the tropics now and before. *Journal of history* **4**:13-34.

[6] Bianchi P.G., Silva, F.S.C., Barros, M.T.(2006). A Rare Intestinal Manifestation in a Patient 4. with Common Variable Immunodeficiency and Strongyloidasis. *Int Arch Allergy Imm*. **140**:199-204.

[7] Dada, B.J.O. and Bellino, E.D. (1979). Prevalence and Public Health Significance of Helminthes Ova in Dog faces deposited on the street of Zaira, Nigeria. *Journal of Annals of Tropical Medicine and Parasitology* **73:**89-90.

[8] Decline, logging and fires in a Southern Swedish Fagus-Picea Forest. *Journal of Vegetation Science* **13**(6):765-774.

[9] Erdtman, G. (1969). *Pollen morphology and plant taxonomy In Angiosperms.* Hafner publication company, New York. 486pp.

[10] Fardet, L., Genereau T, Cabana J, (2006). Severe Strongyloidasis in Corticosteriods2. treated patients. *Clin MicrobiolInfec*. **12**:945-947.

[11] Horner, W.E., Helbling, A., Salvaggio, J.E. and Leher, S.B. (2000). Fungal Allergens. *Clinical Microbiology Reviews* **8:** 161-179.

[12] Lamichhane, J., Adhikary, S., Guatam, P. and Maharjan, R. (2009). Risk of Handling Paper Currency in Circulation Chances of Potential Bacterial Transmittance. *Journal of Science and Technology, Napel* **10**:161-166.

[13] Matur, B.M., Yoila, D.M. and Yvoun, E. (2008). A Survey of parasite cycst and eggs and bacterial on the Nigerian currency in FCT, Abuja. *Journal of New York Science* **3**:1-7.

[14] Niklassson, M., Matts, L. and Leif, B. (2002). A long-term record of Quercus

[15] Nnamani, C. V and Onu. E. (2014). Taxonomic Values of Pollen Features in *Sanna* Genus (Fabaceae) from South- eastern Nigeria. *International Journal of Pharmacy and Biological Sciences* **(9***) 6, 54-59.*

[16] Nnamani, C. V and Uguru, A. N. (2013). Diversity of Honey Producing Plants of Southern Nigeria: Basic

Prerequisite for Conservation and Sustainability. *Journal of Sustainability Science and Management* **8 (1)**, 103-112.

[17] Osayi, E. E , Ezike, D.N and Nnamani, C.V. (2012).Distribution and Abundance of Airborne Palynomorphs in Aku, Enugu State, Nigeria. *BIO-Research* **9 (2)**: 775-779.

[18] Pradeep, N.V., Marulasiddaiah, B.S. and Chetana, M. (2012). Microbial Contamination of Indian Currency notes in circulation. *Journal of Research in Biology* **2**(4):377-382.

[19] Schwendemann, M. L., Wang, G., Mertz, M. L., Mcwilliams, R. T., Thatcher, S. L. and Osborn, J. M.(2007). Aerodynamics of saccate pollen and its implication for wind pollination. *American Journal of Botany* **94** 1371-1381.

[20] Shahali Y, Majd A, Pourpak Z, Tajadod G, Haftlang M and Mostafa M. 2007. Comparative study of the pollen protein contents in two major varieties of *Cupressus arizonica* planted in Tehran. *Iran Journal of Allergy, Asthma and Immunology* **6(3**), 123-127.

[21] Tandan,T., Pollard, A.J., Money, D.M., Scheifele1, D. W.(2002) Pelvic inflammatory disease associated with *Enterobius vermicularis. Journal Arch Dis Child* **86**:439-440

[22] Vadlamudi R.S., Chi D.S., Krishnaswamy G.(2006). Intestinal Strongyloidasis and hyper3. infection syndrome. *Clin Mol Allergy*. **2**;4:8.

[23] Ybert, J. P. (1979). Atlas des pollens de Cote d'Ivoire. Paris: ORSTOM. 45p.

[24] www.ebonyionline.com

Funding

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Authors contribution

Ezike, D. N. developed the concept and the design of the research work, she also interpreted the result of the findings. Ani, O.C. carried out the identification of the microbes. Nwankwo, O.E. and Nwuzor A.N. carryout the sampling. Nnamani C.V. identified the palynotaxa and the revising of the article.