Aeropalynological Survey of Pollen Grains in Khartoum City During 2018

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Abstract

The airborne pollen grains of Khartoum city have been studied during one year from 1 January to 31 December 2018, with Non-volumetric air sampler (Vertical cylinder spore trap). The survey of air borne pollen was conducted at a height of 20 meters. The survey recorded 28 pollen grains types included in 15 families. The pollen morph-types of the family Legminoseae (Fabaceae) members showed the highest concentration (229.8/m³) followed by Poaceae (129.09/m³), Amranthaceae (87/m³), Cyperaceae (42/m³), Aracaceae (39.9/m³), Meliaceae (36.4/m³), Euphorbiaceae (35/m³), Rosaceae (30/m³), Tamarixaceae (20.2/m³), Moringaceae (20/m³), Typhaceae (19/m³), Rhmanaceae (17/m³), Anacardiaceae (15.2/m³) Myrtaceae (9/m³) and Combertaceae (8/m³). Qualitative variation of their number was observed to be affected by season and flowering period of the ground taxa. Maximum pollen load was obtained during autumn (July to October) with an average load of pollen 128.1/m³.

Keywords: airborne; pollen calendar; vertical cylinder trap.

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Introduction

Pollen monitoring of the environment has been extensively carried out in various region of the world. Earlier work was essentially oriented towards qualitative and quantitative estimation of the pollen load in the atmosphere, seasonal variation, pollination biology, preparation of pollen calendar and pollen spectra. With the increasing awareness of pollen as aeroallergen clinical investigations have now formed a routine follow up method associated with aeropalynological surveys (Tilak, 2010). Pollen count varies at different places and is affected by the topographical factors, local vegetation of the area, and meteorological factors (Ziska, et al., 2008) (Khanduri, 2011). The aim of this paper is to study the qualitative and quantitative variation of airborne pollen in Khartoum city and to compile the pollen calendar to guide the doctors (physicians) to diagnosis allergic diseases.

Materials and Methods

Study Area

Field botanical surveys were undertaken regularly for one-year (1 January to 31 December in 2018) to identify and study the plants in various parts of Khartoum city with more emphasis to Khartoum central observatory area. Field trips were conducted monthly, to

each sampling zone and surrounding areas to record botanical observations.

Aeropalynological Survey

Air sampling using Non-volumetric air sampling (Vertical cylinder spore trap) (Gregory, 1951). The operation of the trap was carried out at Al-Neelain University, Faculty of Science and Technology on the 2nd floor of the main building (20 meters above ground level). Vaseline coated 1.8 x 1.8 cm cellophane strip wound on a 5 mm glass rod. The cylinders were changed at 24 hour intervals. After 24 hours' exposure the cellophane strip was removed and mounted on a micro slide using glycerin jelly pre-stained with basic fuchsine. The entire area of the strip was scanned microscopically. The number of pollen grains was expressed as grams per square centimeter of microscope cover glass (22mm × 22mm) (Erdtman, 1952; Walker & Doyle, 1976). The number of pollen grains counted was converted into number per cubic meter of air using the wind records (Ramalingam, 1968). Wind records obtained from the Ministry of Environment, Forestry and Physical Development, Metrological Authority-Weather Climate Data of Sudan.

Identification of Pollen Grains

Identification of pollen types was carried out using reference slides prepared directly from known plants. Continuous observation of the flowering seasons of plants in the vicinity has made it possible to access the major contributing sources of each type of pollen appearing on the sample slides. Beside this, pollen atlases available on the internet and published literature were also consulted. The pollen grains were identified and counted at genus level in most cases, and at family level in the last.

Results

Study Area

Khartoum City is the capital of Sudan; it is located in the middle of the populated areas in Sudan; between the Blue and White Niles; at almost the northeast center of the country between latitudes 15º and 16º north; and between longitudes 31º and 32º east; occupying an area of about 28165 Km² (Wikipedia.Org.com. 2018) in figure (A). The City contains a number of parks, private and public gardens; vegetated with wild, exotic, cultivated, and indigenous plants; also there is Al-Sunt forest which had been planted by *Acacia nilotica* (L.) Delile, in the White Nile bank; in addition to the natural vegetation around the Blue and White Niles. The flowering species frequently observed include *Albizza lebbek* (L.) Benth., *Azadirachta indica* A. Juss, *Caselpinia pulchrrima* (L.) Sw., *Hyphaene thebica* (L.) Mart., *Conocarpus lancifolius* Engl. *Phoenix dactylifera* L., and many species from the families Rosaceae, Legminoseae (Fabaceae) and Poaceae.

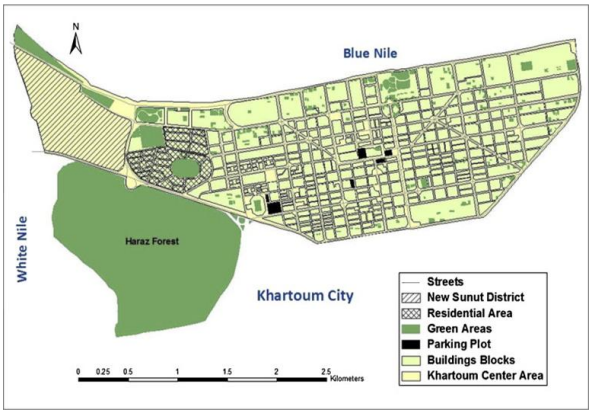

Figure (A): (Khartoum city image from google

Aeropalynological survey

A results of 12-month aerobiological survey showed 28 airborne pollen grains type in the atmosphere in Khartoum city.

Pollen calendar: an estimated number of related group of pollen grains and seasonal variations are shown in figure (1) and table (1).

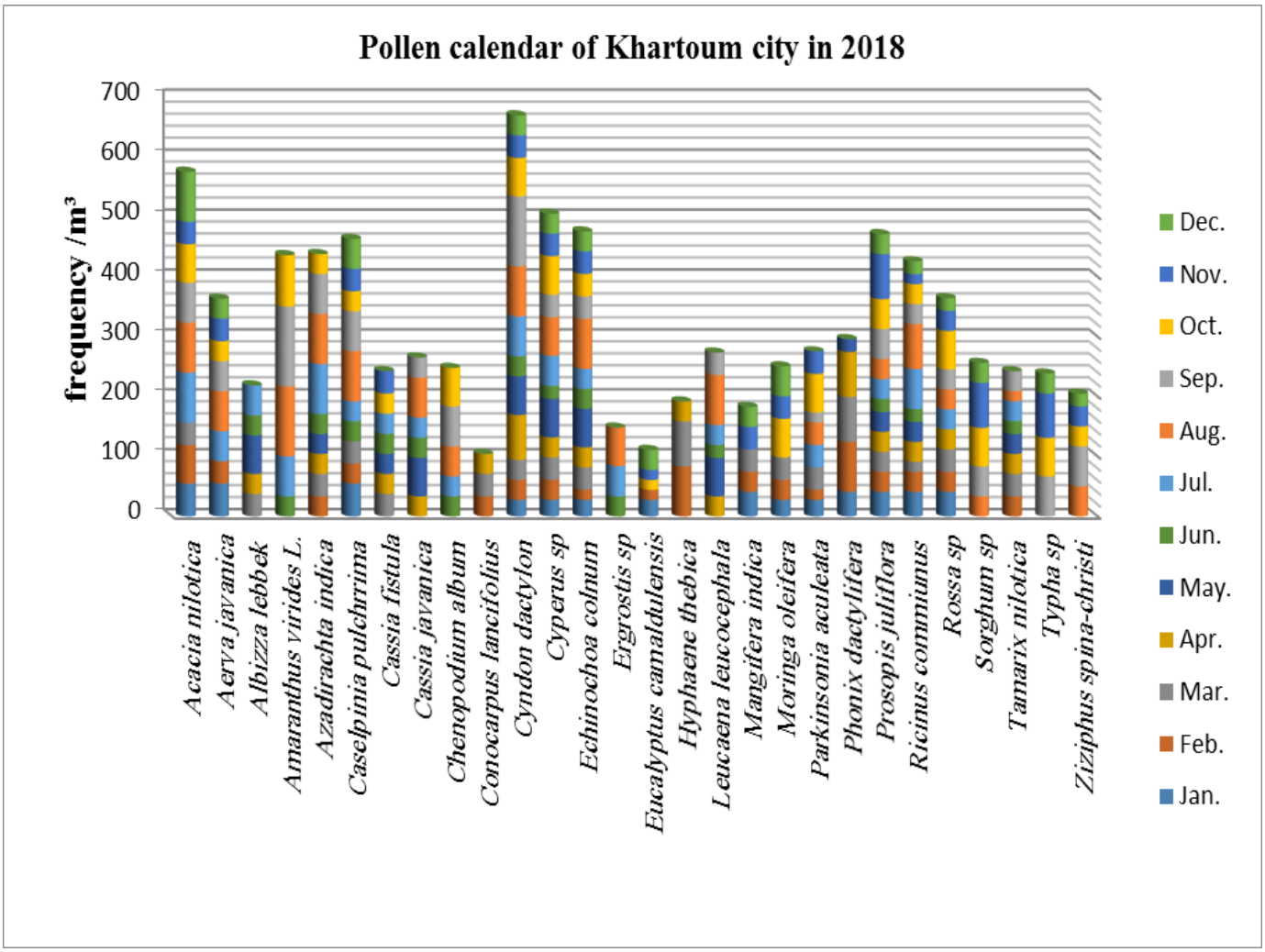

Figure (1): Pollen calendar in Khartoum city in 2018 (Monthly concentration number of pollen grains/m³ of the sampled air)

The Peak of pollen counts showed that the families Poaceae and Amaranthaceae released pollen 11 to 12 months of the year. Altogether (3) pollen types from 28 plant species included within 15 families were recorded and their habits (Life forms), type of pollination and an estimated number of pollen levels recorded are shown in table (1) Figure (2) and Figure (3).

The survey recorded 15 families. The pollen morph-types of the members of the family Legminoseae (Fabaceae) showed the highest concentration (229.8/m³) followed by Poaceae (129.09/m³), Amranthaceae (86.9/m³). Cyperaceae (42/m³), Aracaceae (39.9/m³), Meliaceae (36.4/m³), Euphorbiaceae (35/m³),

Table (1) List of Taxa with Pollination Types, Life forms and Pollen Concentrations

Taxonomic Rank	Type of pollination	Life form	Concentration of pollen /m³
Amaranthaceae			**86.9**
Aerva javanica (Burm.f.) Juss. ex Schult.	An.	Herbs	30.3
Amaranthus virides L.	An.	Herbs	36.0
Chenopodium album L.	An.	Herbs	20.6
Anacardiaceae			**15.2**
Mangifera indica L.	Am.	Tree	15.2
Aracaceae			**39.9**
Hyphaene thebica (L.) Mart.	An.	Tree	24
Phonix dactylifera L.	An.	Tree	15.9
Combretaceae			**8**
Conocarpus lancifolius Engl.	An.	Tree	8
Cyperaceae			**42**
Cyperus sp.	An.	Herbs	42
Euphorbiaceae			**35**
Ricinus commiunus L.	Am.	Shrubs	35
Legminoseae (Fabaceae)			**229.8**
Acacia nilotica (L.) Delile	Am.	Tree	47
Albizza lebbek (L.) Benth.	Am.	Tree	18
Caselpinia pulchrrima (L.) Sw.	Am.	Tree	38
Cassia fistula L.	Am.	Tree	20
Cassia javanica L.	Am.	Tree	22
Leucaena leucocephala (Lam.) Dc.Wit	Am.	Tree	22.7
Parkinsonia aculeata L.	Am.	Tree	22.9
Prosopis juliflora (Sw.) Dc.	Am.	Shrubs	39.2
Meliaceae			**36.4**
Azadirachta indica A. Juss	Am.	Tree	36.4
Moringaceae			**20**
Moringa oleifera Lam.	Am.	Tree	20
Myrtaceae			**9**
Eucalyptus camaldulensis Dehn.	Am.	Tree	9
Poaceae			**129.09**
Cyndon dactylon (L.) Press	An.	Herbs	55.77
Echinochoa colnum (L.) Link.	An.	Herbs	39.63
Ergrostis sp.	An.	Herbs	12.35
Sorghum sp.	An.	Herbs	21.34
Rhamnaceae			**17**
Ziziphusspina-christi (L.) Desf.	Am.	Tree	17
Rosaceae			**30**
Rossa sp.	En.	Herbs, Shrubs	30
Tamaricaceae			**20.2**
Tamarix nilotica (Ehrenb.) Bunge.	An.	Shrubs, Trees	20.2
Typhaceae			**19**

Typha sp.	An.	Herbs	19

An. = Anemophilous, En. = Entomophilous, Am. = Amophiphilous

Rosaceae (30/m³) can be relatively considered to possess moderate pollen concentration. Low concentrations are recorded by Tamarixaceae (20.2/m³), Moringaceae (20/m³), Typhaceae (19/m³), Rhmanaceae (17/m³), Anacardiaceae (15.2/m³) Myrtaceae (9/m³) and Combertaceae (8/m³). Figure (2)

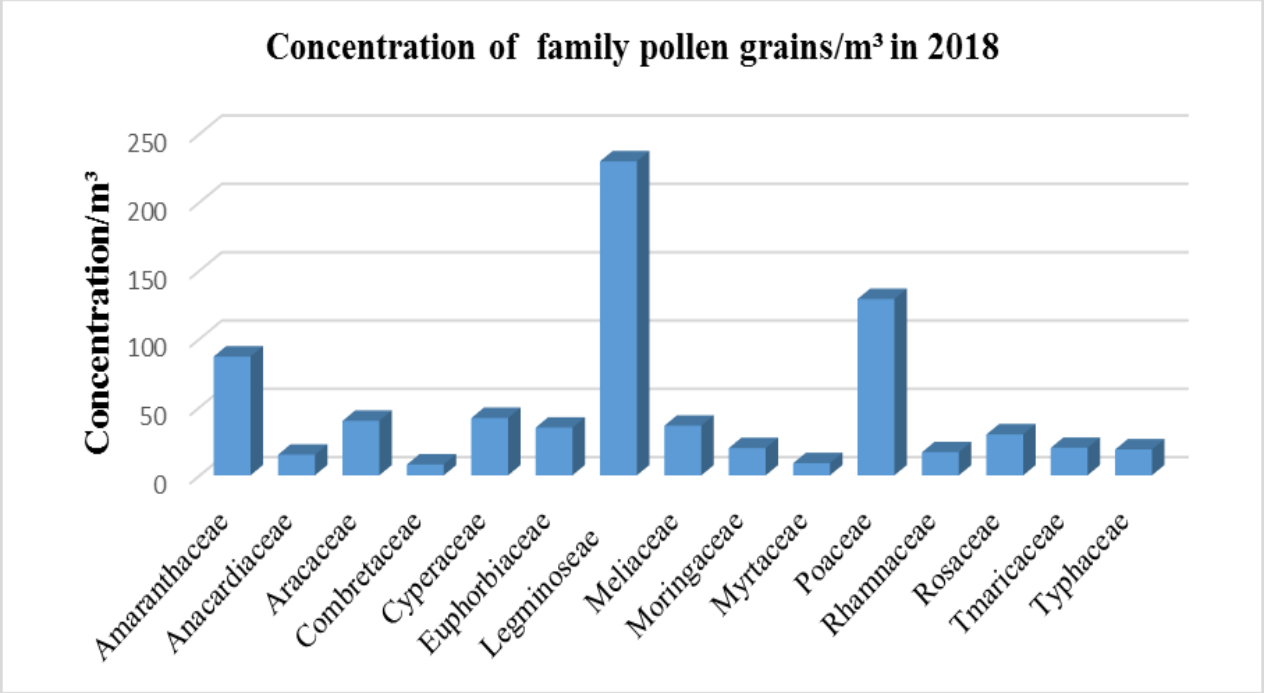

Figure (2): Concentration of families detected on vertical spore trap in Khartoum city\

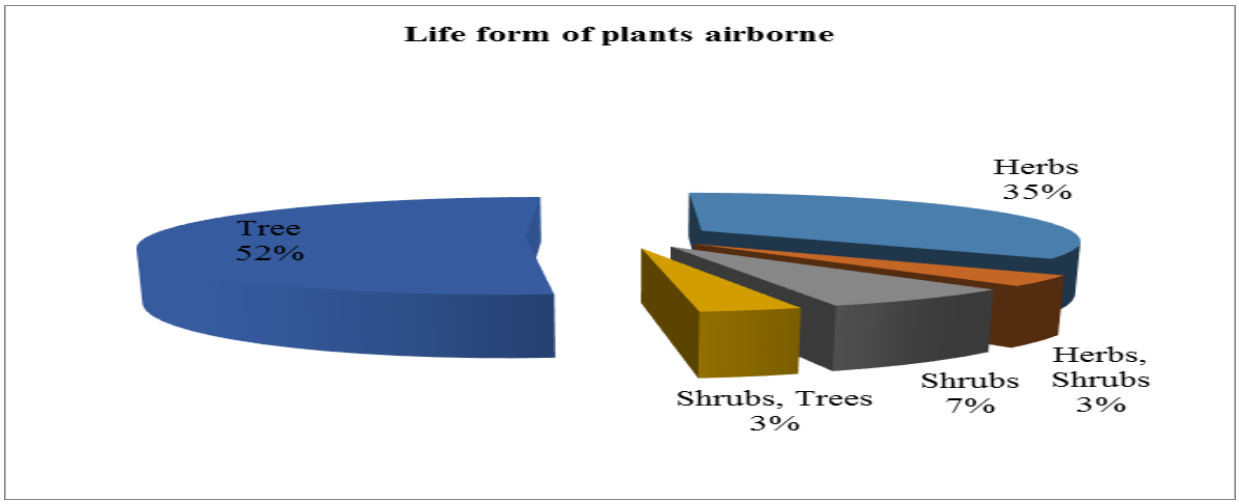

Figure (3): Life form of plants airborne

Seasonal variation of pollen grains/m³

As season variations the concentration of pollen in air began to increase in July and reached their maximum in August, so the highest concentration of pollen were found in autumn (128.1 / m³), followed by winter (87.4 /m³) then summer (83.5 /m³) in table (2).

Table (2) Seasonal variation of pollen grains/m³

Autumn		Winter		Summer	
July	25.2	November	27	March	26.4
August	37.5	December	18	April	22.4
September	32.6	January	18.5	May	20.7
October	32.8	February	23.9	June	14
Total	128.1		87.4		83.5

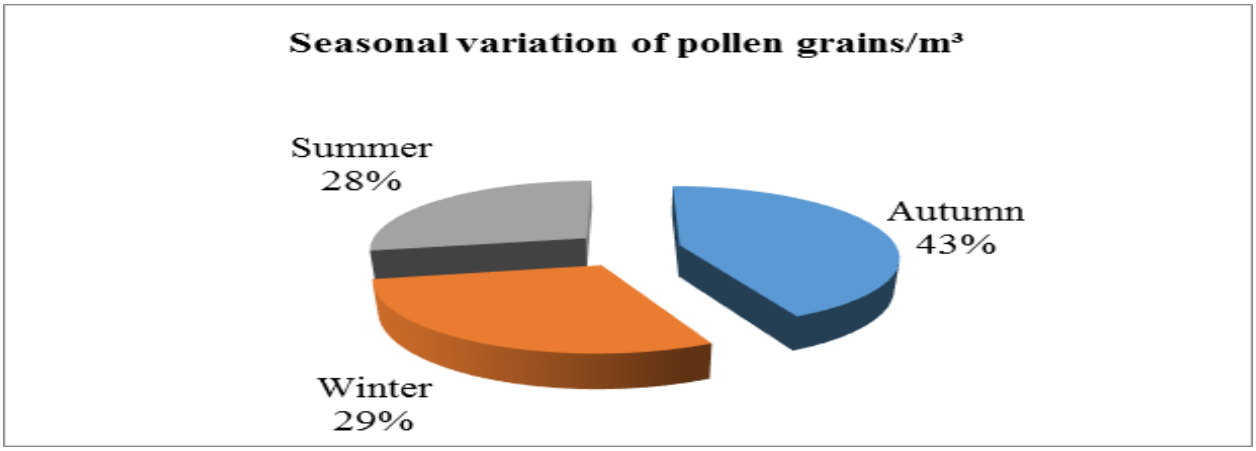

Figure (4): Seasonal variation of pollen grains/m³

No difference was found between count of winter and summer season, but significant difference was found between pollen count of autumn and summer, as well as autumn and summer season.

Discussion

This study is first kind in Khartoum city (Sudan). In this study the pollen members of Leguminosae (Fabaceae) showed the highest concentration (229.8/m³) in the year followed by Poaceae family (129.09/m³), Amranthaceae (87/m³), Cyperaceae (42/m³) in the atmosphere of the city, as season variations the highest concentration of pollen in air were founded in autumn (128.1 / m³), the peak of pollen counts showed that Poaceae and Amaranthaceae released pollen 11 to 12 months of the year. Near results in survey of pollen in Riyadh (Saudi Arabia), showed that Poaceae and Chenopodiaceae

released pollen 11 to 12 months of the year, Chenopodiaceae, Poaceae, *Plantains*, and *Artemisia* were the most common pollens (Al-Frayh, *et al*., 1989). Different results were obtained by Shanta and Mukundraj (2012) in a study of airborne pollen of Rural area around Parbhani (India), it showed that pollens of Poaceae dominated all other typed followed by Fabaceae and Asteraceae and, maximum pollen load were obtained during summer (March-June) with an average load of 408/ m^3 of air. The most common pollens were *Parthenium hysterophorus* (23.87%) followed by Poaceae (16.19%), *Mimosa pudica* (11.31%), *Delonix regia* (8.77%) and *Eucalyptus* spp. (7.58%) were found in the atmosphere of Bangalore city (India), and maximum pollen concentration was observed in the month of May (880/m3) (Roopashree, *et al*, 2014). Also different result was recorded in Afyon (Turkey) the majority of the investigated pollen grains were from *Pinus*, Gramineae, Cyperaceae, Amaranthaceae, Moraceae, Rosaceae and *Salix*, and the highest level of pollen in May (Bicaki, *et al*, 2002). Also in Turkey in 2018 the predominating group was determined to be consisted of pollens of *Pinus* L. (48.23%), Cupressaceae Rich. ex Bartl. Taxaceae Gray (16.74%), Poaceae Barnhart (8.32%), *Quercus* L. (5.31%), *Acer* L. (4.07%), *Platanus* L. (3.10%), *Juglans* L. (2.26%), *Abies* Mill. (1.75%), *Plantago* L. (1.25%), Amaranthaceae Juss. (1.22%) and *Olea europaea* L. (1.16%). The highest pollen count was determined in May and it is striking that most of the determined predominant pollen types have previously been reported as main causes of pollinosis (Akyalçın, *et al.*, 2018). Almost study in the world shared in some families had same airborne pollen grains like Leguminosae (Fabaceae), Poaceae (Gramineae), Amaranthaceae, Roseaceae and Cyperaceae, but had different in concentration in air and different in season concentration. So that may be due to characters of vegetation, different flowering period of plants and geographical location.

Conclusion

Finally, in the Khartoum pollen grains were recorded all year in 2018 round and reached their maximum levels in autumn season, and compile the pollen calendar of Khartoum in this paper may be useful for allergologist to establish an exact diagnosis.

Acknowledgment

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