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# Beekeeping Prospects: Palynology and the Environment

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## ABSTRACT

*Pollen anatomical analysis was made of four pollen pellet samples from honeycombs obtained from four locations in Anyigba, Kogi State. The investigation sought to examine and ascertain the species of plants which were foraged by the honey bees. The pollen pellet samples were acetolysed and analyzed microscopically. A total of forty five pollen types belonging to twenty two families were identified. Identifications were carried to generic level and sometimes to species or only to family levels. Some predominant identified taxa include Elaeis guineensis, Poaceae, Nauclea latifolia an members of the Asteraceae/Tubiliflorae types (Aspilia-Tridax-Chromolaena complex). From this identification, the botanical and geographical origin of each sample were determined and also associated with definite vegetation type (the vegetation of lowland rainforest and Guinea savanna).*

**Key words**: forage, pollen pellets, botanical and geographical origin, taxa.

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## INTRODUCTION

Beekeeping and Apicultural activity is fast gaining more recognition in Africa. Food and Agricultural Organization (FAO) is doing a lot to encourage beekeeping activities in ACP countries as a means of economic empowerment. Honey produced by bees is food, sweetener and of medicinal values (Keku, 2005). Indeed, the chronicle of honey and its value to man is as old as man himself. In ancient mediaeval period, it was so priced that it could be presented to kings.

The activities of bees are multifaceted and so are the motives underlining the practice of beekeeping. In Nigeria, the venture is mainly for the collection of honey. However, much of the honey harvested from bees is by hunting for wild colonies. This results in bush burning, destruction of bees and bee products. The practice also encourages stinging, swarming and absconding.

Bees produce wax to build their combs. The wax is useful in the manufacture of cosmetics, medicine, candles and wax polishes. They produce propolis, made of resinous materials. Propolis is known to have antifungal and antibacterial properties.

As pollinating agents, bees are environment friendly. Foraging bees can cover up to eight kilometers radius for pollen, nectar and resinous substances from plants. This activity is an all year round affairs. Therefore, bees provide a good resource for palynological studies by elucidating the flowering activities of plants within the foraging radii and by implication giving direct evidence of the in situ vegetation. It provides a means of determining the quality of honey i.e. the absence of particles heterogeneous to honey and of pollinations (Vorwohl, 1967, Strake, 1975, Chen et.al, 1984) with the botanical and geographical origin. Hitherto, Melissopalynologists have depended upon the open market or at best beekeepers, for the procurement of honey samples for analysis in order to determine the botanical and geographical origin of honey (Pisani *et al*., 2007). For both, the practice poses potential dangers because it could lead to erroneous conclusions due to the mobility that attends both the practice and this bee product. In Nigeria, the suppliers of honey are mostly the wild honey hunters. Honey procured from an environment may have its origin from a different geographical area (Sowunmi, 1997, Agwu and Akanbi, 1985, Agwu and Okeke, 1997).

The current effort is the direct involvement in beekeeping by palynologists. Apart from removing some of the bottlenecks in the procurement procedure and possible errors in the analytical studies narrated above, it offers the periodical and serial pollen collection for a more accurate assessment of in situ vegetation as well as the production of pollen calendar.

## MATERIALS AND METHODS

A Kenya Top Bar Hive was set up each in an area that is well shaded around Anyigba environ in July 2006. The boxes were placed on iron stands with the legs permanently tipped in lubricants. This was to prevent crawling insects from gaining access into the hives. The boxes were placed such that the entrance faced the east from where early morning light emerges. Pure honey was used to bait the hives until they were colonized in early September, which was the beginning of the seasonal swarming of bees.

About two months after colonization, pollen pellets were collected from cells of the combs in each beehive. Each sample was mixed with 30 ml of warm (35-40$^{o}$c) dilute Tetra-oxosulphate VI acid solutions, 3ml in 997ml of distilled water (Agwu and Okeke, 1997). Each pollen pellet in solution was stirred using glass rod and poured into a centrifuge tube. 30ml of each were centrifuged at 2000 rpm for 5 minutes (Louveaux, 1980). Sediments obtained were washed with acidified water again, centrifuged and decanted to retain precipitate. The precipitates were treated with glacial acetic acid to remove traces of water which could cause explosion on the addition of acetolysis solution. The sediment or precipitate was then acetolysed according to the procedure established by Erdtman (1971) and kept in vials in controlled environment.

### Microscopic Examinations

The content of each vial was properly shaken and stirred with a stirring rod. 1-2 drops of the thoroughly mixed pollen suspension was mounted in glycerin on a clean slide and covered carefully with a cover slip. Care was taken to ensure that the sample covered the slip area evenly so that air bubbles would not be trapped.

The slide was sealed with colorless nail varnish to prevent the sample from dying up. Pollen morphological studies and counts were carried out using Olympus binocular microscope at X40 objective.

The identification of the pollen was done with the aid of descriptions and photomicrographs in books and journals: Bonnefille and Riollet (1980), Ybert (1979), Agwu and Akanbi (1985), among others.

The pollen frequency was based on a count of at least 1200 pollen per sample.

## RESULTS

Pollen grain counts of 1595, 713, 1805 and 2766 were obtained from HPI, HPII, HPIII and HPIV respectively. Analysis of the pollen pellet samples revealed forty-five (45) pollen types belonging to twenty two (22) families. In most cases, identification was carried out up to family level for all pollen types and down to generic level for some and even to species level but some time only to family levels.

Some pollen grains were also identified and could not be separated into individual families due to their similarities; these include Combretaceae/Melastomataceae and Chenopodiaceae/ Amaranthaceae.

The highest number of pollen types was recovered from HPIII where twenty(20) pollen types were recovered while for HPI seven (7), HPII two (2) and HPIV sixteen (16) respectively. Some pollen types were frequent in almost all the sample and these include *Elaeis guineensis, Senna sp,* Poaceae and Asteraceae/Tubiliflorae type which were encountered in all the samples.

The classification recommended by Louveaux *et al.,* (1970) for expressing pollen grain frequencies was adopted: Very frequent (over 45%), frequent (16-45%), rare (3-15%) and sporadic (Less than 3%).

The detailed pollen spectrum of each sample is presented in table I. While the predominant pollen types in each sample is given in Table II. A histogram showing the number of identified pollen types in the four (4) pollen pellet sample are given in Fig. I. Plate I shows a picture of a bee comb containing pollen pellet.

**TABLE I: Pollen spectrum of the pollen pellet samples from four locations in Anyigba, Kogi State**

| S/N | PLANT TAXA | HPI | HPII | HPIII | HPIV |
|---|---|---|---|---|---|
| | DICOTYLEDONES | | | | |
| 1. | AMARANTHACEAE/CHENOPODIACEAE<br>- Amaranthaceae/Chenopodiaceae | - | - | 3 | - |
| 2. | ANACARDIACEAE<br>- *Lannea acida* A. Rich. | - | - | 23 | 159 |
| 3. | ASTERACEAE<br>- Asteraceae Tubiliflorae type (*Aspilia, - Tridax – Emilia – Chromolena* Complex). | 689 | 697 | 387 | 1507 |
| 4. | BOMBACACEAE<br>- *Ceiba pentandra* (L.) gaertn | - | - | 28 | 16 |
| 5. | COMBRETACEAE/MELASTOMATACEAE<br>- Combretaceae/Melastomataceae | - | - | 3 | 32 |
| 6. | EBENACEAE<br>- cf *Diospyros scabra* | - | - | 3 | 2 |
| 7. | CUCURBITACEAE<br>- Cucurbitaceae | - | - | 59 | 32 |
| 8. | EUPHORBIACEAE<br>- *Euphorbia* sp L.<br>- *Phyllanthus amarus* L.<br>- *Securinega virosa* (Roxb. Ex Willd.) Baill | -<br>-<br>4 | -<br>16<br>- | 61<br>163<br>- | 30<br>-<br>17 |
| 9. | FABACEAE<br>- *Senna* sp (ex *Cassia sp*) L. | 6 | - | 40 | 12 |
| 10. | HYPERICACEAE<br>- Hypericaceae *Vismia Guineensis* | - | - | 4 | - |
| 11. | MALVACEAE<br>- Malvaceae p.p.<br>- *Sida acuta* Burm F. | -<br>7 | -<br>- | -<br>- | 6<br>- |
| 12. | MIMOSACEAE<br>- *Parkia biglobosa* (R.B.). | - | - | - | 5 |
| 13. | MYRTACEAE<br>- *Eugenia nodiflora* L.<br>- Myrtaceae *spp*.<br>- *Sygygium guineense* (Willd.) DC | -<br>-<br>- | -<br>-<br>- | 60<br>3<br>- | -<br>-<br>217 |
| 14. | RHAMNACEAE<br>- *Ziziphus sp* Mill | - | - | 20 | - |
| 15. | RUBIACEAE<br>- *Nauclea latifolia* Sm. Syn | - | - | 431 | 180 |
| 16. | SOLANACEAE<br>- *Lycopersicon esculentum* Mill. | - | - | 2 | - |
| 17. | TILIACEAE<br>- *Grewia bicolor* L. | - | - | 14 | - |
| | MONOCOTYLEDONES | | | | |
| 1. | AMARYLLIDACEAE<br>- *Haemanthus multiflorus* Martyn | 159 | - | - | - |
| 2. | ARECEAE<br>- *Elaeis guineensis* Jacq | 11 | - | 487 | 382 |
| 3. | CYPERACEAE<br>- *Cyperaceae* | | | | |
| 4. | LILIACEACE<br>- *Gloriosa superba*, Linn | - | - | - | 47 |
| 5. | POACEAE<br>- Poaceae (cereals) | 720 | - | 8 | 95 |
| | TOTAL NUMBER POLLEN TYPES | **1596** | **713** | **1805** | **2766** |

**TABLE II: Predominant pollen types in pollen pellet sample**

| SAMPLE | POLLEN TYPES | PERCENTAGE | FREQUENCY CLASS |
|---|---|---|---|
| HPI | Poaceae (cereals) | 45.11 | Very frequent |
| | Asteraceae/Tubiliflorae type *Haemanthus* | 43.17 | Frequent |
| | *multiflorus* | 9.96 | Rare |
| | *Elaeis guineensis* | 0.69 | Sporadic |
| | *Securinega virosa* | 0.25 | Sporadic |
| | *Senna sp* | 0.38 | Sporadic |
| | *Sida acuta* | 0.44 | Sporadic |
| HPII | Asteraceae/Tubiliflorea type | 97.76 | Very frequent |
| | *Phyllanthus amarus* | 2.24 | Sporadic |
| HPIII | *Elaeis guineensis* | 26.98 | Frequent |
| | *Nauclea latifolia* | 23.88 | Frequent |
| | Asteraceae/tubiliflorae type | 21.44 | Frequent |
| | *Phyllanthus amarus* | 9.03 | Rare |
| | *Eugenia sp* | 3.32 | Rare |
| | Curcubitaceae | 3.27 | Rare |
| | *Senna sp* | 2.22 | Sporadic |
| | *Ceiba Pentandra* | 1.55 | Sporadic |
| | *Lannea acida* | 1.27 | Sporadic |
| | *Ziziphus sp* | 1.11 | Sporadic |
| HPIV | Asteraceae/tubiliflorae type | 54.48 | Very frequent |
| | *Elaeis guineense* | 13.81 | Rare |
| | *Syzygium guineense* | 7.85 | Rare |
| | *Nauclea latifolia* | 6.51 | Rare |
| | *Lannea acida* | 5.75 | Rare |
| | Poaceae (cereals) | 3.44 | Rare |
| | *Glorisa superba* | 1.70 | Sporadic |
| | *Ceiba pentandra* | 0.58 | Sporadic |

## DISCUSSION

The pollen pellet samples present information on their geographical and botanical origin and also portrayed plants which are bee pollinated. Several of the identified honey plants are important ecological indicator types in the area of production as confirmed by Sowunmi (1978).
The predominance or dominance of a pollen type was considered as an index of bees' activities, preference for a particular plant or group of plants and their feeding activities.

Ten predominant types (Table 11) occur in HPIII together with *Elaeis guineensis* and other plants. The male flower of *Elaeis guineensis* visited by bees for their pollen but the female flowers are not, further more, oil palm trees are wind pollinated and neither of the flowers produces nectar (Agwu, 1985) *Elaeis guineensis* therefore serves the bees as a major source of pollen meal. The same conclusion can also be drawn for some of the other predominant pollen types which may also serve as other major sources of pollen meal to the bees. Some of these pollen types includes members of the Astaraceae family/Tubiliflorae types (*Aspilia*-, *Tridax*-*Chromolaena* – *Emilia* complex), Poaceae (cereals) and *Nauclea latifolia.*

The percentage of important pollen types ranged from "very frequent" to "sporadic". Bees prefer the very frequent and frequent plants.

**Botanical Origin**
Pollen analysis of pollen pellet indicates the presence of pollen grains of different families and different pollen types, probably a reflection of high species diversity characteristic of mosaic of lowland rainforest and secondary grassland (savanna region).

Certain species are common to some while some are found in all the samples despite the fact that the source is the same town but different locations. They include, *Elaeis guineensis,* Asteraceae complex, *Lannea acida, Phyllanthus amarus* and Poaceae, among others.

**Geographical Origin**
Earlier investigation in different parts of the world (Mourizio, 1951, Sowunmi and Agwu, 1976) has shown that the geographical origin of pollen pellet and honey can be established through the pollen content.

According to Sowunmi (1976), most of the Nigerian honey comes from the savanna region (Mosaic of Lowland rainforest and secondary grassland).

The dominance of *Elaeis guineensis, Lannea sp, poaceae, asteraceae* and *Phyllanthus amanus* reflects the vegetation of lowland rainforest and guinea savanna (While, 1983).
The occurrence of *Elaeis guineensis,* Asteraceae complex, *Nauclea latifolia* and *Lannea acida* characterize farmlands and homesteads.

The general vegetation is tropically a Guinea savanna as indicated by the pollen types which include: *Elaeis guineensis*, *Nauclea latifolia*, Asteraceae complex, Poaceae etc. the occurrence of *Syzygium guineense* in HPIV, indicates the existence of forest outlniers in savanna regions.

**Season of Honey Production**
Generally, more plants of the tropics especially trees flower during the period of less rainfall when the sun shines brightly and atmospheric humidity is lower (Agwu and Uwakwe, 1992). The climate conditions are naturally more suitable for the flight of bees. The season of honey production can be related to the flowering period of the plants species represented by their pollen. (Moore and Webb, 1978).

The knowledge of the flowering periods, *Elaeis guineensis* flower all the year round but peaks around October – April, *Nauclea latifolia* (May – June; Nov), Poaceae (Oct – June), *Syzygium guineense* (Nov – May), Asteraceae (April – Dec), L*annea acida* (Jan – April), (Keay, 1989) can permit the deduction of period of collection of each pollen pellet in the beehive.

In HPI the presence of pollen types of Asteraceae complex (*Aspilia – Tridax, Chromolaena – Emilia),* Poaceae (cereals) in large quantity places the period of the pellet collection around April – Jan.; the presence of Asteraceae complex and *Phyllanthus* in sample HPII, indicate that bees might have foraged around December – June. In HPIII, *Elaeis guineensis*, *Nauclea latifolia* and Asteraceae complex indicate that the bees probably gather their food between October – April, the abundance of Asteraceae complex, *Elaeis guineensis* and *Syzygium guineense* HPIV showed that the bees might have foraged between October and May.

## CONCLUSION

The investigation has revealed that the pollen content of the pollen pellets reflect, to a large extent, the floristic composition of the vegetation zone where they were obtained. From result obtained, the pollen pellets were typical ecological indicators of their source locality. The study has shown that the predominant pollen types found within this source locality offer the preferred pollen meal for the bees.

This investigation has also shown the flowering season of some plants and plants that are bee pollinated. The pollen content also reflects the botanical and geographical origins of the pellet samples to permit a useful reconstruction of the local environment.

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