A Study of the Floristic and Nutritional Compositions of Bee Pollen from South Eastern Nigeria

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Abstract: The floristic and nutritional properties of bee pollen from Apis mellifera adansonii and Melipona species were examined using appropriate methods in the laboratory. The pollen pellets obtained randomly from the samples were weighed and recorded accordingly. Each of the pollen pellets contained approximately 6 and 10 plant pollen types with average weights of 0.10g and 0.21g for Apis mellifera adansonii and Melipona species respectively. The plant species identified in their pollen samples varied. This must have been as a result of differences in species preferences. The results of the proximate analysis revealed that Melipona species pollen had higher protein content (20.62%) than Apis mellifera pollen (19.29%). The value obtained from Apis mellifera pollen is lower than the amount required for optimum brood rearing (25% protein) and therefore might be a contributing factor to seasonal absconding of bees during the rains in southeastern Nigeria. However, bee pollen also contains other essential nutrients. The plant species contained in each of the pollen pellets should be inter planted in apiaries. Plants with high protein content that flower during the rains should also be studied. Bee pollen can serve as a protein supplement.

Keyword: Bee pollen, Melipona species and Apis mellifera

1. Introduction

Bees belong to the third largest insect order (Hymenoptera) which also includes wasps and ants. Deforestation resulting from our traditional farming practices, urbanization and modernization continued to reduce the natural habitats and food of the honey bees at a rate which gives little chance for re-establishment of the vegetation. This has led to reduction in honey bee population and colonies.

Apis mellifera adansonii provides various useful products. These include: honey, pollen, propolis, royal jelly, bees wax and bee venom. Honey is referred to as one of the most valuable products of the forest produced by honey bees. It can be used as food and also one of the ingredients in various other industries such as pharmaceutical and cosmetic industries [1]. Besides the importance of Melipona species as major pollinators of most wild plants and some cultivated species, honey and bee pollen of meliponins are also source of food and medicines and income to rural populations [2, 3]. Therefore the rearing of the species becomes important.

Unlike honey and propolis, the scientific study and uses of bee pollen is not yet widely studied in developing countries [4]. Pollen grains are small male reproductive units formed in the anthers of the higher flowering plants [4]. Pollen is a natural source of protein, fat, minerals and vitamins, which are necessary elements for the natural development of a bee colony and likewise in human nutrition [5]. The research work aimed at analyzing the floristic and nutritional compositions of two types of bee pollen (Apis mellifera adansonii pollen and Melipona species pollen).

2. Materials and Methods

2.1 Sample Collection

Pollen samples harvested from colonies of Apis mellifera adansonii and Melipona species located within south eastern Nigeria were used.

2.2 Determination of the Floristic Composition

2.2.1 Determination Number of plants contained per pollen pellet

Ten (10) pollen pellets were randomly selected from each of the samples. The weight of each pollen pellet was taken using a sensitive weighing balance and recorded accordingly as shown in Table 1. Each pollen pellet was dissolved in a beaker with 35ml of warm (40-50°C) diluted sulphuric acid solution [6]. After a thorough shaking of the solution, it was centrifuged, decanted and the residue was acetolysed as described by [7, 8] and then suspended in 3ml glycerin alcohol in plastic vials for microscopic examination. Three drops of the thoroughly mixed suspension was mounted on the slide and examined under the microscope for pollen identification. The identification of pollen under the microscope was carried out with the aid of reference slides and journals by [8, 9, 10, 11 ]. The number of plant species found in each of the pollen pellets per sample was recorded in Tables 2 and 3.

2.2.2 Determination of the floristic compositions of Apis mellifera pollen and Melipona species pollen

1.0g of pollen was taken from each of the well blended pollen samples and prepared as described above and examined under the microscope at magnification 10 x 40 for pollen identification and counts (Table 4).
2.3 Determination of the Proximate Composition of Bee Pollen from South Eastern Nigeria

The proximate analysis was carried out as described by [12, 13, 14].

2.4 Statistical Analysis

T-test was used to compare the means of the two pollen samples (*Apis mellifera adansonii* pollen and *Melipona* species pollen). Significance was tested at 0.05 probability level. Also tables, bar chats were used to analyze the data.

3. Results and Discussion

3.1 Floristic Composition of Bee Pollen Samples from South Eastern Nigeria

Table 1: Weights of pollen pellets from the bee pollen samples collected from southeastern Nigeria.

| Pollen pellets | *Apis Mellifera Adansonii* pollen (g) | *Melipona* sp pollen (g) |
|----------------|--------------------------------------|--------------------------|
| 1              | 0.10                                 | 0.32                     |
| 2              | 0.10                                 | 0.16                     |
| 3              | 0.04                                 | 0.20                     |
| 4              | 0.07                                 | 0.20                     |
| 5              | 0.11                                 | 0.18                     |
| 6              | 0.07                                 | 0.18                     |
| 7              | 0.23                                 | 0.31                     |
| 8              | 0.12                                 | 0.20                     |
| 9              | 0.09                                 | 0.20                     |
| 10             | 0.08                                 | 0.19                     |
| Mean           | 0.10                                 | 0.21                     |

*Apis mellifera* pollen had an average weight of 0.1g and *Melipona* species 0.21g. The variation in weights of the samples must have been as a result of the plant pollen types contained by the samples.
Table 2: Floristic compositions and frequencies of occurrence of pollen pellets extracted from sampled combs of *Apis mellifera adansonii* hives located within Southeastern Nigeria.

| Pollen pellet number | No. of plans pollen type Per pellet | Floristic Compositions | Frequency of occurrence |
|----------------------|-------------------------------------|------------------------|------------------------|
| 1                    | 7                                   | *Lannea* sp            | 9                      |
|                      |                                     | *Dioscorea esculenta*  | 1300                   |
|                      |                                     | *Elaeis guineensis*    | 6                      |
|                      |                                     | *Mimosa pudica*        | 233                    |
|                      |                                     | *Citrus* sp            | 525                    |
|                      |                                     | *Pterocarpus* sp       | 75                     |
|                      |                                     | *Compositae*           | 18                     |
| 2                    | 5                                   | *Elaeis guineensis*    | 1046                   |
|                      |                                     | *Citrus* sp            | 315                    |
|                      |                                     | *Dioscorea esculenta*  | 693                    |
|                      |                                     | *Mimosa pudica*        | 2400                   |
|                      |                                     | *Rauvolfia vomitoria*  | 33                     |
| 3                    | 4                                   | *Dioscorea esculenta*  | 1820                   |
|                      |                                     | *Citrus* sp            | 128                    |
|                      |                                     | *Pterocarpus* sp       | 3                      |
|                      |                                     | *Lannea* sp            | 2                      |
| 4                    | 5                                   | *Dioscorea* sp         | 2150                   |
|                      |                                     | *Citrus* sp            | 1800                   |
|                      |                                     | *Jatropha* sp          | 583                    |
|                      |                                     | *Elaeis guineensis*    | 562                    |
|                      |                                     | *Bartteria nigritiana* | 7                      |
|                      |                                     | *Compositae*           | 1                      |
|                      |                                     | *Elaeis guineensis*    | 28                     |
|                      |                                     | *Citrus* sp            | 400                    |
|                      |                                     | *Mimosa pudica*        | 2225                   |
|                      |                                     | *Lannea* sp            | 556                    |
| 6                    | 4                                   | *Irvingia gabonensis*  | 18                     |
|                      |                                     | *Pterocarpus* sp       | 5                      |
|                      |                                     | *Lannea* sp            | 21                    |
|                      |                                     | *Elaeis guineensis*    | 31                     |
|                      |                                     | *Mimosa pudica*        | 1561                   |
|                      |                                     | *Ipomoea batata*       | 437                    |
|                      |                                     | *Compositae*           | 1                      |
|                      |                                     | *Irvingia gabonensis*  | 9                      |
|                      |                                     | *Corchorus olitorus*   | 108                    |
|                      |                                     | *Bartteria nigritiana* | 23                     |
|                      |                                     | *Pterocarpus* sp       | 1415                   |
|                      |                                     | *Nauclea latifolia*    | 14                     |
|                      |                                     | *Staculia* sp          | 28                     |
|                      |                                     | *Citrus* sp            | 143                    |
|                      |                                     | *Dioscorea esculenta*  | 863                    |
|                      |                                     | *Citrus* sp            | 2                      |
|                      |                                     | *Mimosa pudica*        | 1681                   |
| 7                    | 5                                   | *Elaeis guineensis*    | 4                      |
|                      |                                     | *Ipomoea batata*       | 3                      |
|                      |                                     | *Lannea* sp            | 1115                   |
|                      |                                     | *Bartteria nigritiana* | 1                      |
|                      |                                     | *Khaya* sp             | 324                    |
|                      |                                     | *Hibiscus esculenta*   | 386                    |
|                      |                                     | *Bartteria nigritiana* | 9                      |
|                      |                                     | *Pterocarpus* sp       | 1826                   |
|                      |                                     | *Dioscorea* sp         | 2728                   |
|                      |                                     | *Elaeis guineensis*    | 325                    |
|                      |                                     | *Lannea* sp            | 22                     |
|                      |                                     | *Citrus* sp            | 553                    |
|                      |                                     | *Nauclea latifolia*    | 14                     |
| 10                   | 8                                   | *Elaeis guineensis*    | 4                      |
|                      |                                     | *Ipomoea batata*       | 3                      |
|                      |                                     | *Lannea* sp            | 1115                   |
|                      |                                     | *Bartteria nigritiana* | 1                      |
|                      |                                     | *Khaya* sp             | 324                    |
|                      |                                     | *Hibiscus esculenta*   | 386                    |
|                      |                                     | *Bartteria nigritiana* | 9                      |
|                      |                                     | *Pterocarpus* sp       | 1826                   |
|                      |                                     | *Dioscorea* sp         | 2728                   |
|                      |                                     | *Elaeis guineensis*    | 325                    |
|                      |                                     | *Lannea* sp            | 22                     |
|                      |                                     | *Citrus* sp            | 553                    |
|                      |                                     | *Nauclea latifolia*    | 14                     |

Mean 5.6
Average plant pollen type per pellet = 5.6 plants per pollen pellet.

The results obtained as shown in Table 2 depicts that *Apis mellifera adansonii* stores approximately 6 plants per pellet. This must have been as a result of the wide variety of plants found in southeastern Nigeria. The plant pollens identified were as shown on the table above. The plant pollen types common in all the pollen pellets included *Dioscorea esculenta*, *Mimosa pudica*, *Citrus sp* and *Elaeis guinensis*. The frequencies of occurrence of these plants varied in each of the pellets. This must have been as a result of the flowering periods and preference by the bees. *Dioscorea esculenta* had the highest frequency (1300 pollens) in pollen pellet 1, *Mimosa pudica* (2400 pollens) was the highest in pollen pellet 2. The plant pollens with the highest frequencies in pollen pellets 3, 4, 8, 10, and 5, 6, 7, 9, were *Dioscorea esculenta* with frequencies of 1820, 2150, 863, 2728 and *Mimosa pudica* with frequencies of 2225, 1786 and 1681 respectively.

**Table 3:** Floristic compositions and frequencies of occurrence of sampled pollen pellets extracted from *Melipona Species* colony located within the Southeastern Nigeria.

| Pollen Pellet No. | No. of Plant pollen type per pellet | Floristic compositions | Frequency of occurrence |
|-------------------|-----------------------------------|------------------------|-------------------------|
| 1                 | 10                                | *Andropogon sp*        | 118                     |
|                   |                                   | *Hibiscus esculenta*   | 60                      |
|                   |                                   | *Tapinanthus sp*       | 12                      |
|                   |                                   | *Citrus sp*            | 222                     |
|                   |                                   | *Nauclea latifolia*    | 5387                    |
|                   |                                   | *Lannea sp*            | 6                       |
|                   |                                   | *Irvingia gabonensis*  | 24                      |
|                   |                                   | *Bixa oapi*            | 306                     |
|                   |                                   | *Astracaceae*          | 6                       |
|                   |                                   | *Pterocarpus sp*       | 30                      |
| 2                 | 16                                | *Rauwolfia vomitoria*  | 13                      |
|                   |                                   | *Fumaria elatica*      | 1                       |
|                   |                                   | *Bombax sp*            | 272                     |
|                   |                                   | *Pentaclethra macrophilla* | 420                   |
|                   |                                   | *Lea guineensis*       | 121                     |
|                   |                                   | *Lannea sp*            | 9                       |
|                   |                                   | *Nauclea latifolia*    | 318                     |
|                   |                                   | *Irvingia gabonensis*  | 3                       |
|                   |                                   | *Compositae*           | 11                      |
|                   |                                   | *Tapinanthus sp*       | 68                      |
|                   |                                   | *Citrus sp*            | 3                       |
|                   |                                   | *Combretum sp*         | 1                       |
|                   |                                   | *Newbouldia laevis*    | 639                     |
|                   |                                   | *Pterocarpus sp*       | 13                      |
|                   |                                   | *Hildegardea barteri*  | 63                      |
|                   |                                   | *Dialium guineensis*   | 3                       |
|                   |                                   | *Tapinanthus sp*       | 1347                    |
|                   |                                   | *Compositae*           | 1                       |
|                   |                                   | *Newbouldia laevis*    | 3                       |
|                   |                                   | *Cardiospermum sp*     | 1746                    |
|                   |                                   | *Aliophillus sp*       | 7                       |
|                   |                                   | *Pterocarpus sp*       | 731                     |
|                   |                                   | *Ocimum gratissimum*   | 345                     |
|                   |                                   | *Bixa oapi*            | 78                      |
|                   |                                   | *Lannea sp*            | 11                      |
| 3                 | 10                                | *Andropogon sp*        | 189                     |
|                   |                                   | *Compilae*             | 1                       |
|                   |                                   | *Irvingia gabonensis*  | 7                       |
|                   |                                   | *Citrus sp*            | 13                      |
|                   |                                   | *Spondias mombin*      | 1                       |
|                   |                                   | *Bixa oapi*            | 5                       |
|                   |                                   | *Ehaya sp*             | 11                      |
|                   |                                   | *Nauclea latifolia*    | 943                     |
| 4                 | 9                                 | *Ipomoea batata*       | 1557                    |
|                   |                                   | *Ehaya sp*             | 10                      |
|                   |                                   | *Citrus sp*            | 722                     |
|                   |                                   | *Trichilia sp*         | 12                      |
|                   |                                   | *Combretum sp*         | 1                       |
|                   |                                   | *Bombax bumblebee*     | 18                      |
|                   |                                   | *Spondias mombin*      | 927                     |
|                   |                                   | *Hymenocardia actea*   | 102                     |
|                   |                                   | *Nauclea latifolia*    | 3315                    |
|                   |                                   | *Andropogon sp*        | 17                      |
|                   |                                   | *Lannea sp*            | 23                      |
|                   |                                   | *Jarophia sp*          | 4                       |
|                   |                                   | *Secula sp*            | 5                       |
|                   |                                   | *Ehaya sp*             | 2                       |
|                   |                                   | *Trichilia sp*         | 1                       |
|                   |                                   | *Nauclea latifolia*    | 6624                    |
|                   |                                   | *Hibiscus esculenta*   | 1                       |
|                   |                                   | *Lannea sp*            | 14                      |
|                   |                                   | *Pterocarpus sp*       | 10                      |
|                   |                                   | *Barteria nigrastra*   | 1                       |
|                   |                                   | *Aliophillus sp*       | 6                       |
|                   |                                   | *Bombax bumblebee*     | 5                       |
|                   |                                   | *Andropogon sp*        | 664                     |
|                   |                                   | *Pentaclethra macrophilla* | 47                   |
|                   |                                   | *Irvingia gabonensis*  | 48                      |
|                   |                                   | *Cebia penandra*       | 12                      |
|                   |                                   | *Hildegardea barteri*  | 2957                    |
|                   |                                   | *Triplioclin draceloyn* | 1832                    |
|                   |                                   | *Hibiscus sp*          | 25                      |
|                   |                                   | *Bixa oapi*            | 1                       |
|                   |                                   | *Compositae*           | 1                       |
|                   |                                   | *Cirus sp*             | 30                      |
|                   |                                   | *Terminalia sp*        | 8                       |
|                   |                                   | *Crosipterus, fernfuga*| 19                      |
|                   |                                   | *Terminalia sp*        | 8                       |
|                   |                                   | *Secula sp*            | 3                       |
|                   |                                   | *Andropogon sp*        | 313                     |
|                   |                                   | *Hildegardea barteri*  | 222                     |
|                   |                                   | *Upaca sp*             | 253                     |
|                   |                                   | *Rauwolfia vomitoria*  | 18                      |
|                   |                                   | *Triplioclin draceloyn*| 5038                    |
|                   |                                   | *Bixa oapi*            | 39                      |
|                   |                                   | *Hildegardea barteri*  | 27                      |
|                   |                                   | *Hibiscus esculenta*   | 14                      |
|                   |                                   | *Lannea sp*            | 9                       |
|                   |                                   | *Jarophia sp*          | 9                       |
|                   |                                   | *Pterocarpus sp*       | 4                       |
|                   |                                   | *Pentaclethra macrophilla* | 11                   |
|                   |                                   | *Fumaria elatica*      | 2                       |
|                   |                                   | *Lannea sp*            | 18                      |
|                   |                                   | *Upaca species*        | 5176                    |

Average floristic composition for pollen pellet = 9.6 pollen types per pellet.
Each of the pollen pellets for *Melipona* species varied in their floristic composition with few of the pollen types found in more than one pellet sampled. The results presented in Table 3 above showed that *Melipona* species pollen stored approximately 10 pollen types per stored pollen pellet. Some of the species identified and their frequencies of occurrence were *Nauclea latifolia* (5387), *Newbouldia laevis* (639), *Cardiospermum* sp (1746), *Uapaca* sp (5176), *Nauclea latifolia* (945), *Ipomea batata* (1557), *Nauclea latifolia* (6624) *Hildegardia barteri* (2951), *Andropogon* sp (604), *Uapaca* sp (5176) and were the predominant plant species found in pollen pellets 1 to 10 respectively. These predominant plant species must have been collected by the bees as a result of their preferences to the bees as well as their availability due to their flowering periods. The *Melipona* sp pollen grain showed a higher average number of pollen types (10) per pollen pellet than *Apis mellifera adansonii* pollen (6) per pollen pellet. This might have resulted as a result of differences in species preferences for pollen. Therefore the analysis indicates that the *Melipona* sp collects more plant pollen types than the *Apis mellifera adansonii*. Some of the pollen types collected by the *Melipona* species were also found in the *Apis mellifera pollen*. These plant pollens were *Citrus* sp, *Nauclea latifolia*, *Mimosa pudica*, *Pterocarpus* sp, *Dioscorea* sp, *Uapaca* sp, *Ipomea batata*. The combination of these plant species in each of the pellets by the bees may not be a coincidence but can be as a result of the chemical compositions of each of these plants which are necessary to the bees.

### Table 4: Floristic Compositions of the Bee Pollen Samples from Southern Nigeria

| Floristic composition | *Apis mellifera* pollen Frequency | *Melipona species* pollen Frequency |
|-----------------------|-----------------------------------|-----------------------------------|
| AMPELIDAE             |                                   |                                   |
| *Loea guineensis*     | 12                                | -                                 |
| ANARCARDIACEAE        |                                   |                                   |
| *Lannea* sp           | 591                               | 72                                |
| APOCYNACEAE           |                                   |                                   |
| *Spondias monophylla* | 821                               | 1                                 |
| ARNICA               |                                   |                                   |
| *Azarolus vomitoria*  | -                                 | 31                                |
| BIGNONACEAE           |                                   |                                   |
| *Funtia elastica*     | -                                 | 1                                 |
| COMPOSITE             |                                   |                                   |
| *Newbouldia laevis*   | -                                 | 642                               |
| BOMBACACEAE           |                                   |                                   |
| *Bombax ceiba*        | -                                 | 295                               |
| CAESALPINACEAE        |                                   |                                   |
| *Ceiba pentandra*     | -                                 | 13                                |
| DIATIUM               |                                   |                                   |
| *Elaeis guineensis*   | -                                 | 5                                 |
| COMBRETACEAE          |                                   |                                   |
| *Combretum* sp        | -                                 | 2                                 |
| CONVOLVULACEAE        |                                   |                                   |
| *Ipomea batata*       | 231                               | 2                                 |
| DIOECIORACEAE         |                                   |                                   |
| *Dioscorea* sp        | 440                               | 1557                              |
| EUPHORBIAE            |                                   |                                   |
| *Euphorbia* sp        | 5978                              | -                                 |
| JATROPHA              |                                   |                                   |
| *Jatropha* sp         | 583                               | 13                                |
| UAPACA                |                                   |                                   |
| *Uapaca* sp           | -                                 | 5411                              |
| HYMENOCARDIA SUMATRA  |                                   |                                   |
| *Hymenocardia acida*  | -                                 | 102                               |
| IRVINGIA              |                                   |                                   |
| *Irvingia gabonensis* | 27                                | -                                 |
| LORANTHACEAE          |                                   |                                   |
| *Loranthus* sp        | -                                 | 1427                              |

A total number of eighteen (18) pollen types were identified in *Apis mellifera* pollen sample and twenty eight (28) pollen types were found in *Melipona species* pollen (Table 4). The plant species collected by the bees for pollen collection included *Citrus* sp, *Nauclea latifolia*, *Mimosa pudica*, *Pterocarpus* sp, *Dioscorea* sp, *Uapaca* sp, *Ipomea batata*, *Elaeis guineensis*. These plants had the highest frequencies as indicated in table 4 and have also been identified by Agwu and Agbaeze (1998), Akachuku (2002) as honeybees’ plant species.
The comparative analysis of the two pollens showed highly significant differences as shown in Table 5. The *Melipona* species was higher in Moisture (39.19%), Fiber (3.02%), Fat (2.86), and Protein (20.61) than 20.05%, 2.15%, 1.96%, and 19.10% respectively found in the *Apis mellifera adansonii* pollen. A higher percentage ash (12.80%) and carbohydrate (43.54%) were found in *Apis mellifera* pollen while 12.07% (ash) and 22.24% carbohydrate respectively was contained by the *Melipona sp* pollen. The lower moisture content found in *Apis mellifera* pollen indicated that it has a longer shelf life than the *Melipona* species pollen. Water content of a product determines its shelf life [15, 16, 17]. The crude protein levels were 19.22% and 20.60% for *Apis mellifera adansonii* and *Melipona* species respectively. The results obtained are within the range (7.5 to 35%) reported by [4] as the typical range of protein content of bee pollen. The bee pollen is rich in protein and thus can be taken as protein supplement. The nutritional benefits of protein from various floral sources can be divided into three general categories. Pollens with >25% crude protein were classified as excellent quality, 20-25% crude protein as average quality and <20% crude protein as poor quality [18]. The results were lower than 25% considered as excellent quality of pollen required for optimum brood rearing and colony performance. This must have been as a result of the floral sources of the pollen samples which may not be excellent sources of protein. Relating the most frequent plant species in *Apis mellifera* pollen to their flowering periods, this sample must have been produced during the rainy season, and therefore since the protein content of that sample was not up to the 25% needed for optimum brood rearing might be a contributing factor to the reduction of brood rearing during the rains and also seasonal absconding of bees in southeastern Nigeria. Ample protein promotes a high birth rate and long-lived bees whereas low protein intake minimizes the number of brood reared and the longevity of adult bees [18, 19]. The results obtained from the analysis 19.22% and 20.62% protein were close to the percentage contained by some other good sources of protein such as fish (19%), meat (18%) soybean (34%) common dry bean (22%) as reported by [20]. Therefore pollen can serve as a good source of protein.

### 4. Conclusion

The study showed that the good floral sources of bee pollen required by the bee species in southeastern Nigeria included: *Mimosa pudica*, *Citrus species*, *Pterocarpus sp.*, * Dioscorea sp.*, *Ipomea batata*, *Nauclea latifolia* and *Uapaca sp.*

**Table 5:** T-test of the Proximate Compositions of Bee Pollens of *Apis-mellifera adansonii* and *Melipona Species*

| Sample     | Moisture | Crude fibre | Ash | Fat | Protein | Carbohydrate |
|------------|----------|-------------|-----|-----|---------|--------------|
| *Apis mellifera* | 20.05    | 2.51        | 12.80 | 1.96 | 19.10   | 43.54        |
| *Melipona sp*   | 39.19    | 3.02        | 12.06 | 2.86 | 20.61   | 22.24        |
| T-cal          | -35.05   | -23.49      | 4.61  | -38.92 | -5.97  | 32.70        |
| Sig (2-tailed) | .000     | .000        | .010  | .000  | .004    | .000         |

\[\text{Values are the means of three replicates}\]

The *Melipona* species collected a wider variety of plants than the *Apis mellifera adansonii*. However, *Apis mellifera adansonii* frequencies of visits to the different plants are higher. *Apis mellifera* stores approximately six (6) plants per pellet while the *Melipona* species stores approximately eleven (10) plant species per pellet. It has also been found from this analysis that bee pollen contains all the essential nutrients. The percentage protein contained in the sample are lower than the adequate amount needed for optimum brood rearing and colony production and might be a contributing factor to seasonal absconding of bees during the rain. However, the following recommendations are made: the identified floral sources of bee pollen should serve as a guide to beekeepers in establishing farms (apiaries). The plant species found in each of the pollen pellets should be inter-planted in apiaries as the availability of these plant species will enhance pollen quality and quantity. Also, the identified plants should be conserved. Research, should be carried out on individual plant pollen to determine the nutrient composition of each plant species especially for these plants that are frequently visited by the bees to determine their contributions to colony growth.

**References**

[1] Akachuku CO Conserving the natural forest biodiversity in Niger delta through sustainable keeping. NAAS proceeding 2001; pp 229-309.

[2] Freitas BM A vida das Abelhas craveiro e craveiro, Fortaleza, CE, Brasil CD.Rom 1999.

[3] Tania MS, Silva Celso A, Camera Antomo CS, Lins Mariade Fatima Agra,Eva MS, Silva Igor T, Reis Breno M, Freitas Chemical composition, botanical evaluation and screening of radical scavenging activity``of collected pollen by rhestingless bees *Melipona rugiventris* (Urucu-amarela). Anais de Academia Brasileira de Ciencias, 2009; pp 2.

[4] FAO Value-added products from beekeeping .FAO of United Nations Agricultural services bulletins, Rome, 1996; pp124.

[5] Cobo A EL pollen: problematicaY perspectivas El campo.1984, Pp 69-77.

[6] Lieux MH Acetolysis method; a revised description.1969; p564-565.

[7] Erdtman G The acetolysis method; a revised description.1969; p564-565.

[8] Agwu COC and Agbaeze CC Palynological study of honey from Anambra and southern Benue state of Nigeria. *Journal of science and technology* 1992; (2):357-362.

[9] Sowunmi MA Pollen grains of Nigerian plants I (woody species) Grana 1973; 13:145-186.

[10] Sowunmi MA The potential value of honey in palaeopalynology and Archaeology. Review of palaeobotany and palynology 1976; 21; 171-185
[11] Sowunmi MA. Pollen of Nigeria plants II (woody species), Ibadan Nigeria 1995; p 1-4.
[12] AOAC Official methods of analysis. Association of official chemists, Washington, DC, USA, 1995; pp2-15.
[13] James CS. Experimental method of analytical chemistry of foods. Chapman and hall, New York 1995.
[14] Pearson D. The chemical analysis of food 7th ed. Church hill store, London 1976; pp. 572.
[15] Serra Bonvehi J; Gomez Pajuelo A; Gonell Galindo F. Larecolte du pollen Rev.fr. Apic. (1987a), 464,300-301.
[16] Serra Bonvehi J; Gomez Pajuelo A; Gonell Galindo F. Sechage at conservation du pollen Rev frome. 1987b; Apic.465, 54- 355.
[17] Jodral M; Fernaridez C; Bentabol A; Linain. E. Elpolen apicola comosustrato parala produccion de aflatoxinasi (Aglatoxin formation in bee pollen.) Alimentaria, 1992; 236, 67-68.
[18] Kleinschmidt G and Kondos A. The influence of crude protein levels on colony performance. Australasian beekeeper 1976; 79,251-257.
[19] Schmidt JO, Schmidt PJ. Pollen digestibility and its potential nutritional value. Bee cult, 1978; 112, 320-322.
[20] Shubhangini A. Joshi. Nutrition and Dietetics, Second Edition, Tata Mc Grew-Hill publishing company limited, New Delhi 2000.