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DIVERSITY OF HONEY PRODUCING PLANTS OF SOUTHERN NIGERIA: BASIC PREREQUISITE FOR CONSERVATION AND SUSTAINABILITY

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Abstract: Honey is a natural product that acts directly on our biological systems in a significant number of ways. Amongst the many health benefits of honey are its antioxidant, antifungal, anticancer and bacteriostatic properties to its free fat and cholesterol values.Today, the density and availability of these plant species which honey bees forage for nectar are threatened by the vicious impart of climate change, environmental degradation and over exploitation by man for his livelihood options. Systematic identification and documentation of these species is the basic prerequisite for their conservation and sustainability. The major aim of this work was to evaluate palynologically after acetolysis the pollen spectrum of five honey samples from three zones in Southern Nigeria. The results showed diversity of fifty-sixty (56) honey plants belonging to twenty one (21) plant families distributed within 53 genera comprising of 19 dicots and 2 monots. Three predominant families were frequently encountered, these were Fabaceae, Euphorbiaceae and Anacardiaceae contributing a total of 1672.74 plants pollen with 983.45 (58.79%), 372.9 (22.29%) and 316.3 (18.9%), respectively. Fabaceae contributed the highest honey plant of (9) species *Senna hirsuta* L, *Danialla oliveri* (Rolfe) Hutch & Dalz. *Brachystegia eurycoma* Harms*, Senna occidentale* L. Link, *Isoberlinia dokas* Craib & Stapf*, Erythrina senegalensis* D.C*., Albizia zygia* (DC.) Macbr*, Tephrosia bracteolate* Guill. & Perr, *Tephrosia purpurea* L., *Parkia biglobosa* (Jacq) R. *ex* Don-H.C., *Entada abyssinica* Steud. *ex* A. Rich., *Crotolaria retusa* L. and *Dialium guineense* Willd. Predominant honey plants were *Anacardium occidentale* L, *Ageratum conyzoides* L, *D.oliveri*, *Alchornea cordifolia* Muell, Arg, *Trichilia spp* and *Elaeis guineensis* Jacq. with 31.14, 32.48, 39.9, 58.74, 35.26 and 60.92 %, respectively. The result equally reflected the habit and conservation status of these predominant honey plants. Apart from *A. occidentalis* and *E. guineensis* which are cultivated, others are found in the wild and are vulnerable to climate variability and change (threatened). Poor pollen spectrum recorded in some samples could be a reflection of loss of bioresources attributed to high level of anthropogenic activities. It is therefore, recommended that policy makers and indeed beekeepers in these zones as a matter of urgency should embark on extensive propagation, afforestation, and conservation of these predominant honey plants within their apiaries to improve food security, income generation for farmer's and as carbon repossession in the ecosystem.

KEYWORDS: *Apis mellifera* L, conservation, pollen spectrum, Southern Nigeria, threatened honey plants

Introduction

Pollen is the dietary supplement that bees introduce into their hive to feed the colony in times of food scarcity. They contain all the nutrients required by the human body and are enormously rich in proteins, vitamins, minerals, beneficial fatty acids, carotenoids, and bioflavonoids which have anti-viral and antibacterial properties. It is also helpful in lowering cholesterol, stabilizing and strengthening blood capillaries (Krell, 1996). According to Jones and Bryant (2004), pollen found in honey is used to determine honey's type, genuine and the floral sources.

Various (2010a) stressed that the production of honey is an eco-friendly activity that encourages good agricultural practices

in maintaining the agricultural ecosystem balance, biodiversity conservation, promoting the sustainable use of natural resources, environmental quality and human health.

However, the population of honeybee (*Apis mellifera* L.) has experienced serious decrease in Europe, North America and the world in general (Neumann and Carreck, 2010). These losses highlight the potential risks for our natural and agricultural biodiversity through lack of pollination, and the repercussions on food security and human nutrition (Ratnieks and Carreck, 2010). It has been recognized that a lack of food and particularly the dearth of pollen, within intensively farmed agricultural landscapes and degraded environment as a result of anthropogenic activities have actually contributed to the loss of plant species which honey bees forage for pollen. Other biotic factors such as availability of plant genetic resources and their ability of these plant species to blossom, compete for resources, fight against pathogens, parasites, predators, and abiotic factors such as climate and pollutants are all contributory factors to this decline (Gounari, 2006). Potts, *et al*., (2010) affirmed that nutritional stress due to habitat loss has played an important role in the collapsed of honeybee colonies.

To date, the density and survival of these plant species are been threatened not just by the above factors but by the vicious impart of climate change and land degradation. Consequent to the global level of food security and its associated effects, there is a great deal of concerns on the declines of these two bioresources all over the world.

Palynology is the science of pollen and spore morphology and that has found its applications in mellisopalynology, aeropalynology, pollenasis, plant taxonomy, biogeography, climatology, stratigraphic correlation of oil bearing rocks and pharmacopalynology. Meo and Khan (2004) stressed that, pollen analysis has been significantly utilized as a means of tracing the history of cultivated and uncultivated plants.

Samuel and Luchsinger (1979) reported that, as a result of the stimulus in the discovery and the availability of Scanning Electron Microscope (SEM), taxonomists no longer overlook pollen as the basic source of data in identification and phylogeny. They further pointed out that, the availability of countless pollen samples from herbaria sheets and the relatively fast techniques for their preparation, allows palynological survey of many taxa in relatively short period of time.

Some of the taxonomic characters provided by pollen and spore include exine stratification, sculpturing pattern of the wall, polarity, symmetry, shape, apertural types, pollen sizes and pollen form index. Cronquest (2001) stated that exine details of pollen are such that they can be used in plant identification much in the same way as that of fingerprints used for the identification of criminals.

At international levels there have been explosion of information published on many aspects of pollen and spores in respect to botanical and geographical origin of honey. Several workers such as Mumtaz *et al.,* (2000); Perveen and Qaiser, (2007); Passarelli *et al*., (2010) have utilized pollen morphology in the identification and reconstruction of many families of angiosperms.

In Nigeria, the earliest references on pollen analysis as a tool in the identification of flora sources of honey were dated back to late seventies, when notable researchers like (Sowunmi, 1976; Agwu and Akanbi, 1985; Agwu *et al.,* 1989; Agwu and Abaeze, 1991; Agwu and Uwakwe, 1992; Sowunmi, 2001; Agwu and Njokuocha, 2004; Nnamani and Agwu 2007; Nnamani and Agwu, 2008) have used pollen morphology in assessing the diversity of honey producing plants. Their works have currently provided commendable quality data on the pollen spectrum of some honey samples in some states in Nigeria without much from the Southern Nigeria. This present study is anchored on the systematic identification of flora diversity foraged by honey in Southern Nigeria in order to bridge this gap. This will go a long way to enhance their sustainability and conservation, particularly in Nigeria. The present study aims at 1) taxonomic identification of honey plants and its diversity which honey bees forage for their pollen and nectar sources in Southern Nigeria,

2) to determine the predominant honey plants in this zone and 3) to assess and elucidate the conservation status of these honey plants.

Materials and Methods

Sample Collection

Honey samples were sourced during the major honey production periods of the year between January and March 2011, from five locations within Southern Nigeria: three from Ebonyi State (Iboko, Isieke and Ezzamgbo), one from Nsukka in Enugu State (Ibagwa) and one from Obudu cattle ranch in Cross River State. The samples were collected directly from local beekeepers who harvested honey from their hives, stored in clean bottles and later transferred to the laboratory for acetolysis.

Preparation of the Pollen Content

The five honey samples were vigorously shaken to have a fair distribution of the biological components. Ten (10) grams of each of the samples were weighed out with the aid of Microwa 7720 sensitive beam balance into well labeled beakers and diluted with 35ml of warm dilute sulphuric acid solution (Lieux, 1972). The samples were sieved with thin network of meshed wire gauze to remove unwanted plant tissues. The acidified honeys were centrifuged for 5 minutes at 2000 revolution per minute (RPM), decanted and later washed with 5mls of distilled water. Thirty-five (35ml) of glacial acetic anhydride together with 1ml of dilute sulphuric acid solution was added to the samples and later were centrifuged at 2000 revolutions for 15 minutes. The solutions were decanted to recover the precipitates.

Acetolysis

The recovered precipitates were finally acetolysed using Erdtman (1971) acetolysis method of 9: 1 (conc. sulphuric acid and acetic anhydride solutions) with some minor modifications. The precipitates were then boiled in water bath for 10 minutes at 100^{O}C and centrifuged at 2000 RPM for 5 minutes. They were decanted to recover the precipitates which were later stored in 10 drops of glycerin in plastic vials.

Microscopy

For microscopic study, four slides were prepared from each sample and examined for pollen contents under the light microscope at x40 magnification. The pollen count was based on the method recommended by Louveaux *et al* (1978) and identified using Ybert (1979). The honey samples containing more than 45% of a single type of pollen were considered as unifloral honey. Frequency classes were determined as predominant pollen types (>45%), secondary pollen types (>16-44%), moderate pollen types (>3-15%) and minor pollen types (>3%) (Jones and Bryant, 2004).

Photomicrographs of some major predominant honey plants were also taken.

Results

The assessment of the five honey samples recorded fifty-sixty (56) honey plants belonging to twenty one (21) families (comprising of 19 dicots and 2 monots) distributed within 53 genera (Table 1 and Plate 1). Three predominant families were frequently encountered during the analysis and contributed the highest number of the plants pollen totaling 1672.74. These families were Fabaceae 983.45 pollen grains (58.79%) coming form 13 plant taxa, Euphorbiaceae 372.9 pollen (22.29%) and Anacardiaceae 316.3 (18.9%) (Table.2).

Predominant honey plants recorded from the analysis were *Elaeis guineensis Trichillia Alchornea cordifolia, Daniella oliverii, Ageratum conyzoides* and *Anacardium occidentalie* in the quantum of 304.6, 176.3, 293.7, 199.5, 162.4 and 155.7, respectively (Fig. 1).

The result equally reflected the habit and conservation status of these predominant honey plants from Southern Nigeria. Aside from the *A. conyzoides* that is an herbaceous species all the other predominant honey plants were trees, found in the wild and are prone to environmental threat (Table 3). Photomicrographs of pollen of some of these predominant honey plants are shown in (Plate 1).

Table 1: Percentage Occurrence of Honey Plants in the five Honey Samples from Southern Nigeria. (10g in %).

Family	Pollen Taxa	Ibo	Obu	Isk	Nsu	Ezz
Acanthaceae	*Acanthus montanus* (Nees) T. Anders	-	-	24	-	-
Arecaceae	*Elaeis guineensis* Jacq	46.2	68.5	72.0	59.9	58
Anacardiaceae	*Spondias mombin* L.	34.2	11.0	28.4	35	14.5
Anacardiaceae	*Lannea acida* A. Rich	-	-	4.5	3.0	-
Anacardiaceae	*Anacardium occidentale* L	45.2	30.1	13.8	34.5	32.1
Araliaceae	*Cussonia barteri*	15	-	-	15	10
Asteraceae	*Ageratum conyzoides* L	45	21	34	17.4	45
Malvaceae	*Bombas buonopozenese* P. Beauv	32.1	21.5	37	14	21
Caricaceae	*Carica papaya* L	2.5	-	2.5	3.8	1.5
Cochlosper-maceae	*Cochlospermum planchonii* Hook. F.	20.1	2.3	2.7	21.9	23.4
Combretaceae	*Terminalia glaucescens* Planch & Benth.	12.2	30	16.5	17.8	14.5
Combretaceae	*Combretaceae* Type	14.3	2.4	6.7	-2.4	2.6
Curcubitaceae	*Luffa cylindrica* M. J. Roem	4	2.6	1	-	1
Chrysobal-anaceae	*Parinari curatellifolia* Planch ex Benth	9.3	6	9.8	3.2	10.9
Ebenaceae	*Diospyros mespiliformis Hochist xe* ADC.	8.2	11.3	12	20.2	11.2
Euphorbiaceae	*Bridelia micrantha* (Hochst.) Baill	3	10	-	12	4
Euphorbiaceae	*Securinega virosa* (Roxb ex Willie) Baill.	6.8	10.4	-	5.1	-
Euphorbiaceae	*Manihot esculenta* Crantz	-	-	1.1	2.5	1.6
Euphorbiaceae	*Phyllanthus muellerianus* (O. Ktz) Exell.	-	-	12.5	-	-
Euphorbiaceae	*Alchornea cordifolia* Muell, Arg.	54	45	84.7	45	65
Euphorbiaceae	*Hymenocardia acida* Tul.	1.1	2.8	2.6	1.6	2.1
Fabaceae	*Isoberlinia dokas* Craib & Stapf	-	-	22	-	-
Fabaceae	*Albizia zygia* (DC.) Macbr	10	10	10	20.1	13.4
Fabaceae	*Senna hirsuta* L	3.2	2.5	4.9	21.2	2.5
Fabaceae	*Daniella oliveri* (Rolfe) Hutch& Dalz.	12.9	54.7	45.6	48.2	38.1
Fabaceae	*Brachystegia eurycoma* Harms	20.4	23.1	16.5	2.4	4.0
Fabaceae	*Senna occidentalis* (L.) Link	17.2	12.1	9.38	28	20.1
Fabaceae	*Dialium guineense* Willd	10.9	23.5	9.8	8.0	7.2
Fabaceae	*Parkia biglobosa* (Jacq) R. ex Don-H.C.	9.06	3.1	27	12.3	10

Fabaceae	*Entada abyssinica* Steud. Ex A. Rich	-	1.0	-	-	-
Fabaceae	*Erythrina senegalensis* D. C.	17.5	38.0	34.4	28.1	13.4
Fabaceae	*Tephrosia bracteolate* Guill. & Perr	12.9	35.4	44	23.9	23.7
Fabaceae	*Tephrosa purpurea* L	-	-	18.6	-	-
Fabaceae	*Crotolaria retusa* Linn.	-	5.5	-	1.7	-
Irvingiaceae	*Irvingia wombolu* Okafor ex Baill	23.4	43.7	11.3	13.0	30.1
Loganiaceae	*Anthocleista vogelii* A. Chev.	12.0	5.9	1.2	6.4	9.2
Meliaceae	*Azadirachta indica* Juss.	12	-	3	7.9	4.2
Meliaceae	*Trichilia spp*	34	53	33.0	45.1	11.2
Moraceae	*Milicia excelsa* (Welw) C.C	3.7	5,8	12	24.9	10.12
Moraceae	*Treculia africana* Decne.	33	43.2	34.0	29	34
Olacaceae	*Olax subscorpioidea* Oliv.	-	20	-	-	13
Poaceae	*Andropogon gayanus* Kunth var. gayanu	-	8.9	52	-	-
Proteaceae	*Protea madiensis* Oliv.	23.1	25.1	33.1	11	15.2
Ranuncu-laceae	*Clematis hirsute* Guill &Perr.	35.3	23.2	26.4	21.2	14.8
Rhamnaceae	*Lasiodiscus mannii* Hook. F. var.	21.6	25.8	-	-	-
Rubiaceae	*Nauclea latifolia* Smith.	30.1	21.5	14.2	43.3	26.9
Rubiaceae	*Crossopteryx febrifuga* Afzil ex Benth	-	2.6	32.8	45	54
Rutaceae	*Zanthoxylum zanthoxyloides* (Lam.) Zepernichk	5.1	2.2	2	-	9.1
Sapindaceae	*Allophylus africanus* P. Beauv.	38	-	34.8		-
Sapindaceae	*Paullinia pinnata* L	6.7	12	2.8	7.4	10
Sapindaceae	*Lecaniodiscus cupanioides Planch. Ex Benth.*	-	-	3.8	-	-
Ulmaceae	*Trema orientalis* L	-	2.0	-	-	-
Ulmaceae	*Celtis intrifolia* Lam.	24.3	12.3	11.0	12	13.6
Verbenaceae	*Vitex doniana* Sweet.	-	-	2.9	-	-
Vitaceae	*Cissus quadrangularis* L	11.7	31.0	20.8	-	3.3
Vitaceae	*Cissus spp*	12.5	16	23.4	21.3	5.09
Unidentified		20	17	16	23	10
Total Pollen		912	1937	786	1324	592

Legend: Ibo = Ibiko, Obu = Obudu, Isk = Isieke, Nsu = Nsukka, Ezz = Ezzambgo.
- = absence of pollen type in the honey sample.

Table 2: Frequency of predominant plants families in the five honey samples (10g).

Family	Pollen Taxa	Ibo	Obu	Isk	Nsu	Ezz	Total
Anacardiaceae	*Spondias mombin*	34.2	11.0	28.4	35	44.5	
	Lannea acida	-	-	4.5	3.0	-	
	Anacardium occidentalis	45.2	30.1	13.8	34.5	32.1	
Sub-Total	**316.3 Pollen grains**						**18.9%**
Fabaceae	*Senna hirsute*	3.2	2.5	4.9	21.2	2.5	
	Danialla oliveri	12.9	54.7	45.6	48.2	38.1	
	Brachystegia eurycoma	20.4	23.1	16.5	2.4	4.0	
	Senna occidentalis	17.2	12.1	9.38	28	20.1	
	Dialium guineense	10.9	23.5	9.8	8.0	7.2	
	Isoberlinia dokas	-	-	22	-	-	
	Erythrina senegalensis	17.5	38.0	34.4	28.1	13.4	
	Albizia zygia	3.2	2.5	4.9	21.2	2.5	
	Tephrosia bracteolate	12.9	35.4	44	23.9	23.7	
	Tephrosia purpurea	12.9	35.4	44	23.9	23.7	
	Parkia biglobosa	9.06	3.1	27	12.3	10	
	Entada abyssinica	-	1.0	-	-	-	
	Crotolaria retusa	-	5.5	-	1.7	-	
Sub-Total	**983.45 pollen grains**						**58.79%**
Euphorbiaceae	*Bridilia micrantha (Hochst.) Baill*	3	10	-	12	4	
	Securinega virosa (Roxb ex Willie) Baill.	6.8	10.4	-	5.1	-	
	Manihot esculenta Crantz	-	-	1.1	2.5	1.6	
	Phyllanthus muellerianus (O. Ktz) Exell.	-	-	12.5	-	-	
	Alchornea cordifolia Muell, Arg.	54	45	84.7	45	65	
	Hymenocardia acida Tul.	1.1	2.8	2.6	1.6	2.1	
Sub-Total	**372.9 pollen grains**						**22.29%**

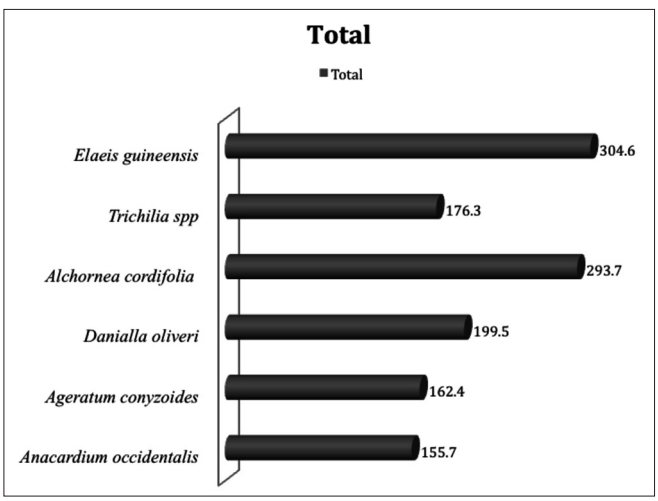

Figure 1: Total number of predominant honey plants identified in five honey samples from Southern Nigeria.

Table 3: Habit and conservation status of predominant honey plants determined from pollen in five honey samples from Southern Nigeria.

Taxa	Habit	Conservation Status	Source	Other Uses
A. occidentalis	*Tree*	Threatened	Cultivated	Food/Medicinal
A. conyzoides	*Herb*	Not threatened	Wild	Medicinal
D. oliveri	*Tree*	Threatened	Wild	Medicinal
A. cordifolia	*Tree*	Threatened	Wild	Medicinal
Trichilia spp	*Tree*	Threatened	Wild	Medicinal
E. guineensis	*Tree*	Not/ Threatened	Cultivated	Food/Medicinal

Discussion

The five honey samples from the three states of Ebonyi, Enugu and Cross- River States in Southern Nigeria gave an insight on the diversity of plants resources where honey bees forage for their dietary supplement in the zone. Fifty six (56) honey plants were recorded and all were characteristic flora of Tropical and Mosaic of Low Land Rainforest taxa.

The 56 plant species were higher than the 42 recorded by (Agwu and Njokuoch (2004) from Eastern Nigeria, although the study area for the present work varied. However, these could not compare favourably with the 91 species identified from Ebonyi State (Nnamani and Agwu, 2007). This could be a reflection of the level of environmental degradation/ degrees of biodiversity loss that may be attributable to climate variability and change and/or imparts of anthropogenic activities within these ecological zone. However, the 56 plant resources reflected the rich flora source of these zones.

Predominant Flora Family

A total of 56 honey plants belonging to 21 plant families (Table1) of 19 dicots and 2 monocots were recorded. Three families were constantly encountered during this assessment. These families were Fabaceae, Anacardiaceae and Euphorbiaceae (Table 2) with Fabaceae contributing the highest number of 9 species, *S. hirsute, S. occidentalis, D. oliveri, B. eurycoma, D. guineense, I. dokas, E. senegalensi, T. bracteolate, T. purpurea and C. retusa.* These species are relics of rain forest taxa characteristics of derive savannah vegetation.

Predominant Honey Plants

In relation to individual plant germplasm most frequently visited by honey bees in this vegetation zone. The result showed five predominant honey plants (Table 3), in all the five samples, *Elaeis guineensis* a cultivated plant, was the most frequently foraged, contributing 3304.6 (60.92%) of the total predominant honey plants, followed by *Alchornea cordifolia 293.7* (58.74%). Others were *Danialla oliveri* 199.5 (39.9%), *Trichillia* spp 176.3 (35.26%) *Ageratum conyzoides* 162.4 (32.48%) and *Anacardium occidentalie* 155.7 (31.14%) (Fig.1). Aside from *Elaeis guineensis* and *Anacardium occidentalie* all others are wild plants which are exposed to various levels of environmental hazards. These predominant honey plants *(Elaeis guineensis Alchornea cordifolia Anacardium occidentalie Trichillia* and *Ageratum conyzoides*) are vestige of the Tropical Rainforest vegetation belt, characteristic plant species of mosaic of the lowland forest and secondary vegetation, found in Southern Nigeria. This was in line with the reports of Agwu and Abaeze (1991), Nnamani and Agwu, (2008), which in their various studies identified these species as good floral sources for pollen and nectars. Suffice it to say that *Elaeis guineensis* is not an enthermophyllous plant; it still stands out as a good nectarfilous source of pollen for honey bees. This has actually confirmed the statement of (Agwu personal comm.) the species which has a good aroma that attracts bees to the plant. This work confirmed the rich species diversity of the forest- savannah Eco-zone of Southern Nigeria (Ofomata, 1975). Similarly, Agwu and Abaeze (1991) and

Nnamani and Agwu, 2008) in their studies in South-eastern Nigeria identified the abundance of these species and used them to determine the geographical and botanical origins of those honey plants found in their honey samples.

Alchornea cordifolia and *Danialla oliveri* pollen were equally frequently encountered in these honey samples from Southern Nigeria. These families were abundant and are good indicator species reflecting the characteristic plants of the derived savannah found in most part of Southern Nigeria. As illustrated in (table 1) other pollen plants characteristic of the zone were *Albizia zygia, Sterculia africana, Cassia hirsute, Hymenocardia acida* and *Nuclear latifolia* and *Trichilla* sp. As these plants are good nectariferous taxa, they play important roles in apiculture within these regions and should be protected and conserved for sustainable development in Nigeria.

Honey Type

The result of these analysis showed that more than fifty honey plants species were identified from the five samples, given these samples a multifloral honey types. However, the presence of *Elaeis guineensis* to the quantum of 46, 68, 72, 59 and 58% and greater than the (>45%), as recommended by (Jones and Bryant, 2004), in all samples qualified these honey samples to be regarded as monofloral honey. This is in line with the result of Gomes *et al.* (2011) who identified 46% Lavender pollen from five organic honeys from Portugal and recommended it as monofloral honey in their work. However, bees forage different plants; thus, honey is always a mixture of several floral sources. This is in conformity with the report by Ameenah (2011), who stated that traditional medicine often aims to restore balance by using chemically complex plants, or by mixing together several different plants in order to maximize a synergistic effect or to improve the likelihood of an interaction with a relevant molecular target. Similarly, differences in their composition also mean differences in the organoleptic and nutritional properties of these honeys.

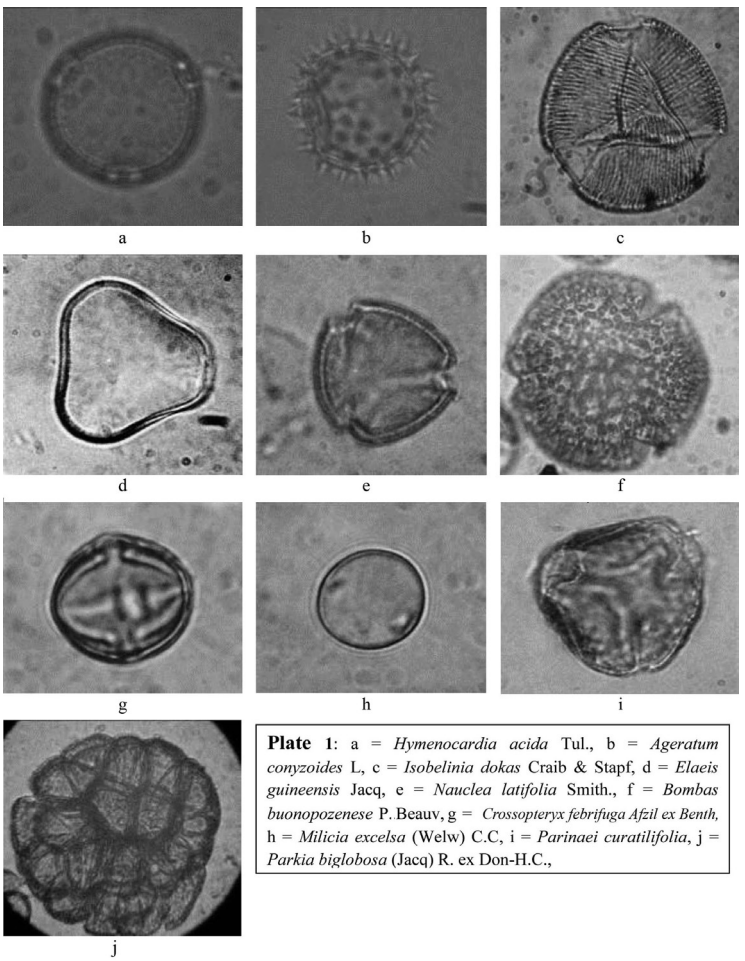

Plate 1: a = *Hymenocardia acida* Tul., b = *Ageratum conyzoides* L., c = *Isobelinia dokas* Craib & Stapf, d = *Elaeis guineensis* Jacq, e = *Nauclea latifolia* Smith., f = *Bombas buonopozenese* P. Beauv, g = *Crossopteryx febrifuga Afzil ex Benth,* h = *Milicia excelsa* (Welw) C.C, i = *Parinaei curatilifolia*, j = *Parkia biglobosa* (Jacq) R. ex Don-H.C.,

The above is a reflection of the report by ASICUMPON, (2005), who reiterated that many members of some families of angiosperms such as Anacardiaceae, Fabaceae and Euphorbiaceae have been implicated to elaborate high potency of bioactive compounds. Species such as *Spondias mombin, Lannea acida,*

Anacardium occidentalis, Bridilia micrantha, Securinega virosa, Manihot esculenta, Phyllanthus muellerianus, Alchornea cordifolia and *Hymenocardia acida* are used topically in ethno medicine as abioficent and for the treatment of fever, diabetics and other types of illness. This study has shown their dominating influence as important and prevalent honey plants in these zones.

Status of these Genetic Plant Resources

Apart from *A. occidentalis* and *E. guineensis* which are cultivated, other honey plants may be in a vulnerable state as most of taxa are found in the wild species. Considering the level of climate variability and change on biodiversity globally and the tropics in particular, coupled with environmental degradation, they could be threatened. Therefore, the policy makers should take charge for urgent policy intervention on sustainable conservation.

Poor pollen spectrum recorded in some samples could be a reflection of loss of bioresources attributed to impart of climate change and high level of anthropogenic activities in these zones. This is in line with the report by Potts *et al.* 2010) who suggested that nutritional stress due to habitat loss has played an important role in honeybee colony collapse, and thereby stressed the usefulness of protecting and enhancing the availability of floral resources by using rules and policies for efficient environmental management and conservation.

Conclusion

The diversity of predominant honey producing plants such as *A. occidentale*, *A. conyzoides*, *D.oliveri*, *A. cordifolia*, *Trichilia spp* and *E. guineensis* identified from this study has actually highlighted the rich diversity of honey producing species of Southern Nigeria and their conservation status. These species make a significant contribution to the livelihood options of the poor rural farmers who depend on honey extraction for their main source of income. Honeybees enhance agricultural productivity and help maintain biodiversity by providing valuable pollination services. Therefore effective policy programmes should be placed for the propagation and protection of those predominant taxa such as the Fabaceae species to avoid genetic erosion in future. Moreover, the contribution of honey in mitigating malnutrition and hidden hunger cannot be over emphasized while carbon sequestration effects of plant genetic resources globally has attracted so many discuss. It is therefore; recommended that policy makers to conduct programmes for their sustainable management and protection and indeed to beekeepers in these zones to embark on extensive propagation, afforestation, and conservation of these predominant honey plants particularly members of the Fabaceae family, as honey bees have much preference of species from this group within their apiaries. This will go a long way to enhance food security, reduction in hidden hunger/malnutrition and at the same time serve as a tool for carbon sequestration within these Eco zones. The cost of inaction far outweighs the financial implication of ensuring a safe and healthy environment for the present and future generations.

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