DOMINANT POLLEN IN HONEY SAMPLES FROM FOUR BEEHIVES IN ABEOKUTA, SOUTHWEST, NIGERIA

Olushola H. Adekanmbi and Olugbenga S. Alebiosu
Sholaadekanmbi2000@yahoo.com, olugbengaalebiosu@gmail.com

Abstract
In the quest to examine the preferentially foraged pollen by honey bees in Abeokuta, Nigeria, a palynological study was conducted on honey samples from four bee farms; Owudekudu, Olorunda, Agbede and Odeda, all situated within Abeokuta, Ogun State, Nigeria. Honey samples were collected and subjected to acetolysis, followed by slide preparation and microscopy of the treated samples. Twelve pollen types were recovered from the four honey samples and some of these pollen are common to the four honeys. A classification method for expressing pollen frequency class was adopted: Very frequent (Over 45%), Frequent (16-45%), Rare (3-15%) and Sporadic (Less than 3%). The most abundantly recovered pollen grains in the four locations were those of Berlinia grandiflora, Albizia sp., Bombax buonopozense, Asteraceae and Fabaceae. Pollen of Elaeis guineensis, Rutaceae, Amaranthaceae, Combretaceae/Melastomaceae, Senna sp., Poaceae and Convolvulaceae were also recovered. The results of this study indicate that these plants were preferentially foraged by honey bees in the sample locations. This might have been influenced by more suitable nutritional contents of these pollen grains produced by their parent plants, although yet to be investigated. Hence, there is need for an appropriate conservation strategy of these plants from destructive human activities such as indiscriminate felling of trees and forest clearing for agricultural and urban developmental projects. The results from this work have established these plants as preferential to bee forage in Nigeria.

Key words: Honey bees, palynological, pollen frequency, preferential.

Introduction

Mellisopalynology is basically the study of pollen and spores in honey. Pollen content of honey samples have been earlier studied with inferences on the botanical sources, geographical provenances and standardization of honeys. In Nigeria, such works have been carried out by Sowunmi (1976), Agwu and Akanbi (1985), Agwu and Njokuocha (2004), Ayodele *et al.* (2006), Ige and Apo (2007), Nnamani and Agwu (2007; 2008), Adekanmbi and Ogundipe (2009), Ige and Modupe, (2010), Adeonipekun (2010), Aina and Owonibi, (2011), Adeonipekun (2012) amongst others. Adeonipekun (2010) studied pollen pellets and a honey sample from an apiary in Ibadan, Nigeria. He stated that size is a seeming determinant of the pollen types recovered from the honey samples and that bees would not travel far as long as there are forages of good quality close by. In his 2012 research, he conducted a palynological work on the middle and edge sections of a

honeycomb and a pressed honey sample from an apiary in Lagos, Nigeria. The middle section of the comb yielded higher abundance with lower diversity; the comb edge sample had higher diversity but lower abundance, while the pressed honey had higher proportion of small sized pollen with a relatively higher diversity than the middle section but lower diversity than the edge portion. The higher diversity and lower abundance of the comb edge assemblage reveal that honeybees probably began the filling of the honey comb and later moved outwards.

A direct observation of foraging bees in Northern Nigeria was done by Dukku (2013). This aided the identification of a total of 61 savanna plant species visited by the honey bee, with Fabaceae having the largest number of species represented. An extended flowering period of plants was identified to have supported the available forage to the bees throughout the year. Nnamani and Uguru (2013) revealed the pollen spectra of five honey samples from three ecological zones in Southern Nigeria. A total number of 56 honey plants belonging to 21 plant families were represented. Of these, Fabaceae had the highest number of represented plant species. Kayode and Oyeyemi (2014) conducted a palynological study of twelve honey samples collected in two successive years from different areas in Ekiti State, Nigeria. They pointed out that their period of honey collection covered two distinct seasons: rainy and dry seasons in the study area. It was noted that this favourable climate influenced the establishment of a flourishing vegetation, supporting beekeeping and honey production. They found *Alchornea cordifolia*, *Elaeis guineensis*, *Spondias mombin* and Asteraceae as important plant taxa encountered in their study. Ige and Obasanmi (2014) assessed the pollen contents of 25 honey samples collected from five different locations in Delta State, Nigeria. The dominant pollen types found are Combretaceae/Melastomaceae, *Lannea* sp., *Elaeis guineensis*, *Syzygium* sp., amongst others. However, there is still a paucity of data on the type of parent plants producing pollen that are typically used as bee forages, especially in bee farms with little or no knowledge about their potential to increase more yield in honey production.

This present study was conducted with a view to identify the preferentially foraged plants by honey bees in the sample locations, as dominated by a mosaic of lowland rain forest and an open vegetation type.

Materials and Methods

Honey samples were collected from four different bee farms; Odeda, Owudekudu, Olorunda and Agbede with their co-ordinates: 7.21'N 3.51^{o}E, 7.43^{o}N 3.64^{o}E, 7.25^{o}N 3.45'E and 7.15^{o} N 3.42^{o}E respectively. These samples were subjected to acetolysis treatment following Erdtman (1969), after which slide preparation and microscopic analysis of prepared residues of honey samples were carried out. Identification of pollen grains was done using photomicrographs in reference journals including Sowunmi (1973; 1995), Adekanmbi (2009), Gosling (2013) and unpublished albums. The classification

recommended by Louveaux *et al.* (1970) for expressing pollen frequency class was adopted; Very frequent (over 45%), Frequent (16-45%), Rare (3-15%) and Sporadic (less than 3%). Photomicrographs were taken using a Motic 2300 digital camera.

Results

Twelve different pollen types were identified in the palynological analysis of the four honey samples. Seven were identified to family level; two were identified to generic level and three to species level; others were either morphologically described or termed pollen indeterminate. The recovered pollen grains were of diverse morphological features, belonging to plants of different growth forms. There was a similarity in the pollen types recovered in the four locations studied. A total of 7, 8, 12 and 9 pollen types were identified in Agbede farm, Olorunda farm, Odeda farm and Owudekudu farm respectively. The most abundant taxa were *Berlinia grandiflora, Albizia* sp., *Bombax buonopozense*, Asteraceae and Fabaceae. Other represented taxa were Amaranthaceae, Rutaceae, *Elaeis guineensis*, Combretaceae/Melastomaceae, *Senna* sp., Poaceae and Convolvulaceae. Quantitatively, the palynological data also revealed high pollen abundance in all the honey samples studies: 179, 1196, 1486 and 2229, for Agbede, Olorunda, Owudekudu and Odeda respectively with a total of 4920 in all the four honey samples.

Table 1: The Pollen Count, Pollen Relative abundance and Pollen frequency class of different plant taxa represented in the study

		SAMPLE LOCATIONS											
		Odeda			**Olorunda**			**Owudekudu**			**Agbede**		
S/NO	**Plants represented**	**Pollen count**	**R.A (%)**	**P.F.C**	**Pollen Count**	**R.A (%)**	**P. F.C**	**Pollen count**	**R.A (%)**	**P.F.C**	**Pollen count**	**R.A (%)**	**P.F.C**
1	Psilatricolporites sp.	387	17.4	Frequent	332	29.75	Frequent	684	46.03	Frequent	44	24.58	Frequent
2	Poaceae	8	0.35	Sporadic	6	0.54	Sporadic	4	0.26	Sporadic	2	1.11	Sporadic
3	Tricolporites	107	4.80	Rare	-	-	-	74	4.98	Rare	-	-	-
	Tricolpites pollen				2	0.18	Sporadic						
4	Asteraceae	352	15.79	Frequent	184	16.22	Frequent	114	7.67	Rare	14	7.82	Rare
5	*Bombaxbuonopozense*	359	16.11	Frequent	37	3.31	Rare	159	10.69	Rare	21	11.73	Rare
6	Combretaceae/ Melastomaceae	136	6.10	Rare	-	-	-	26	1.75	Sporadic	-	-	-
7	*Berliniagrandiflora*	389	17.45	Frequent	318	28.49	Frequent	152	10.23	Rare	48	26.81	Frequent
8	*Albizia* sp.	161	7.22	Rare	196	17.56	Frequent	182	12.24	Rare	371	20.67	Frequent
9	*Elaeisguineensis*	245	10.99	Rare	29	2.6	Sporadic	87	5.85	Rare	13	7.26	Rare
10	Amaranthaceae	6	0.2	Sporadic	-	-	-	2	0.14	Sporadic	-	-	-
11	A Pollen tetrad	-	-	-	-	-	-	1	0.07	Sporadic	-	-	-
12	Pollen Indeterminate	-	-	-	-	-	-	1	0.07	Sporadic	-	-	-
13	cf. *Senna*sp.	77	3.45	Rare	12	1.07	Sporadic	-	-	-	-	-	-
14	Convolvulaceae	1	0.05	Sporadic	-	-	-	-	-	-	-	-	-
15	Lamiaceae/Labiatae	1	0.05	Sporadic	-	-	-	-	-	-	-	-	-
	TOTAL	**2229**	**100%**		**1116**	**100%**		**1486**	**100%**		**513**	**100%**	

Key: R.A= Relative Abundance; P.F.C =Pollen Frequency Class; V.F. = Very frequent (over 45%); F = Frequent (16-45%); R = Rare (3-15%) and S = Sporadic (<3%).

Discussion

From the palynological data obtained for the four honey samples analysed, the Odeda farm honey contains the highest number of pollen concentration and pollen types, while the Agbede farm honey recorded the lowest pollen concentration and pollen types (table 1). This denotes that the honey produced by bees within the Odeda farm is richer in pollen content, while that of the Agbede farm is poorer in pollen content. The pollen spectra of all the samples displayed less diversity with a greater abundance of plants represented. This is in contrast to many previous works including that of Nnamani and Uguru (2013) who reported a diversity of 56 honey plants, belonging to 21 plant families distributed within 53 genera and comprising of 19 dicots and 2 monocots. In their findings, they also recovered a considerable abundance of plant pollen with a total of 912, 1937, 786, 1324 and 592 from the palynological analysis of five honey samples produced in the southern Nigeria. These reported pollen abundances are also similar to that of this present study. Of all the recovered pollen grains, the most abundantly recovered were those of *Berlinia grandiflora*, *Bombax buonopozense*, *Albizia* sp., Asteraceae and Fabaceae. The abundant representation of Fabaceae is in conformity with the findings of Dukku (2013) and Nnamani and Uguru (2013). It is worthy of note that the palynological analysis of these honeys yielded a similarity in their pollen spectra. This could have been influenced by a probable similar physiognomy of the surrounding vegetation prevalent in the bee farms, since these farms are situated within the same area, although still distant apart from one another.

From the palynological data, it was observed that the honey bees foraged greatly on trees, compared to other growth forms. From the phytoecological grouping, it can be deduced that the surrounding vegetation of the four bee farms is that of a mosaic of lowland rain forest and secondary vegetation. This is in agreement with the findings of Agwu and Abaeze (1991), Nnamani and Agwu (2008) and Nnamani and Uguru (2013). It is expedient to note that *Elaeis guineensis* and Asteraceae having no nectar are only polliniferous in nature, (Nnamani and Uguru, 2013), hence they are not among the plants represented in the pollen spectra that contributed to the honey produced by bees. Aina *et al*. (2015) quoted the findings of Agwu and Akanbi (1985), stating that *Elaeis guineensis* (oil palm tree) is wind pollinated and neither the male nor female flowers of this plant produce nectar. They further affirmed that *Elaeis guineensis* provides a major pollen meal source to the bees. According to Nnamani and Uguru (2013), poor pollen spectrum recorded in honeys could be a reflection of loss in the diversity of plants to be foraged by bees due to anthropogenic and natural factors. Potts *et al*. (2010) also suggested that nutritional stress due to habitat loss has played an important role in honey bee colony collapse. The sampled bee farms of this present study are not likely to have been under this influence, considering their positions within the characteristic low land rain forest type, as well as the secondary vegetation. This confirms the possibility that the honey bees were selective in their foraging habits, based on the nutritional status of the foraged

pollen grains (Baker and Baker, 1982), or even as a result of an appreciable production of the pollen grains by their parent plants.

The inferred surrounding vegetation of the bee farms; a mosaic of low land rainforest and secondary vegetation is unequivocally characteristic of the tropical rain-forest belt in the present-day southern Nigeria, according to the work of Nnamani and Uguru (2013).

Conclusion

This study has revealed the pollen spectra of plants remarkably foraged by honey bees in the source locations. The nutritional status of pollen produced by these plants should be further investigated. These plants should however be well protected from anthropogenic influence such as the traditional indiscriminate felling of trees and bush burning. Bee farmers rearing honey bees in these locations should also situate their bee-hives in closer proximity to these plants, in order to ensure a greater yield in the honey production by the honey bees and foster a better source of income.

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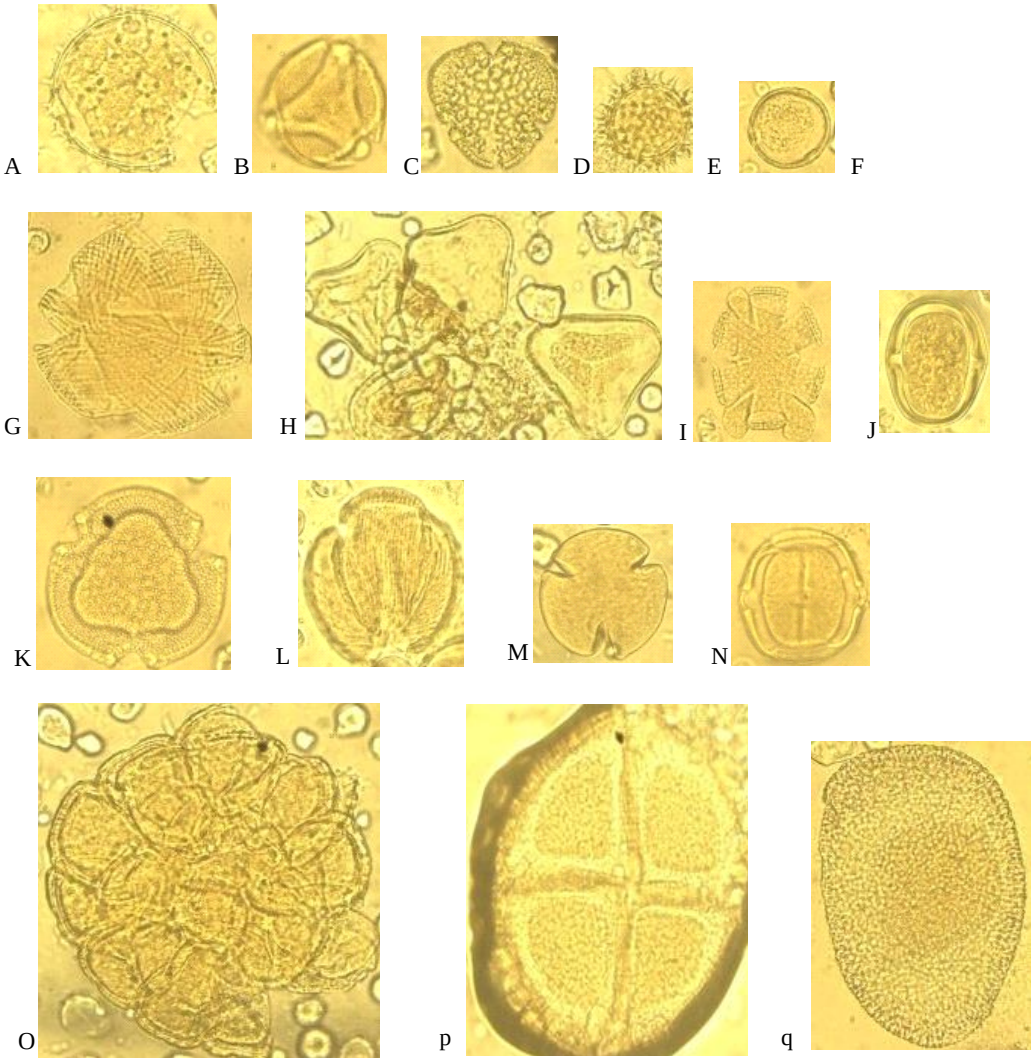

Plate 1: Photomicrographs of some identified pollen grains in the study
A- Convolvulaceae; B- *Senna*sp., C and K- *Bombaxbuonopozense*; D- Asteraceae; E- Rutaceae; F- Tricolporites sp., G and L- *Berliniagrandiflora*; H- *Elaeisguineensis*;
I- Lamiaceae/Labiatae; J and N- Psilatricolporites sp., M- Tricolpites sp., O- *Albizzia*sp., P- Pollen tetrad and Q- Pollen Indeterminate. (All Magnification: x40 objective).