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Apis florea honeys from Vikarabad district of Telangana State of South India–A pollen based study

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Abstract
Melissopalynological studies deals with the identification of bee forage plants and has a significant application in apiculture. In Telangana state, beekeeping activity involving the hive bees is practically non-existing. Eight honey samples of *Apis florea* collected from Vikarabad district during summer March-May, 2021 were palynologically analysed with a view to identify the botanical origin of honey samples. For the recovery, analysis, and quantification the methodology recommended by International Commission for Bee Botany (ICBB), Louveaux *et al*, 1978, was followed. Seven samples were unifloral/monofloral in nature and one multifloral. *Alternanthera sessiles, Sphaeranthus indicus, Carum copticum, and Ageratum conyzoides* pollen types were recorded in predominant condition in the samples studied. The other noteworthy pollen types include *Cajanus cajan, Tinospora cordifolia, Tridax procumbens, Ricinus communis, Leucaena leucocephala, Psidium guajava, Celosia argentea, Chenopodium album, Bassia latifolia etc.* Altogether 26 pollen types referable to 16 families were recorded. The information from melissopalynological studies plays a very important role in the identification of the bee flora of the study area.

Keywords: unifloral honeys; pollen analysis; Apis Florea f, Vikarabad district; Telangana state, s. India

Introduction
Melissopalynology is an important branch of Palynology which finds a significant application in the field of Apiculture/Beekeeping. Melissopalynological studies deals with the qualitative and quantitative analysis of pollen present in honeys and pollen loads of bees and beehives of diverse floristic and geographical regions. Pollen grains which are recovered from honey samples and pollen loads are the only source / key for the identification of bee forage plants. Pollen grains recorded from the honey samples provide information regarding nectar source plants and pollen recorded from pollen loads gives information regarding pollen source plants. This information is useful in beekeeping activities. Apiculture / Bee-keeping ventures involving the hive bees is practically non-existing in Telangana state of South India. Vikarabad, one of the newly formed district of Telangana state and farmers of this region are dependent on agriculture. On an ongoing melissopalynological studies of Telangana region, efforts are made to study the honeys samples of Vikarabad district, with an aim to identify the bee forage plants and to assess this area for any bee-keeping activity.

Materials and Methods
Study area
Vikarabad district of Telangana state was formed during 2016. The district is spread over an area of 3,386.00 square kms. It is situated between 17° 20' 11.1480" N and 77° 54' 17.4456" E. It is bounded by the districts of Sangareddy, Rangareddy, Mahaboobnagar and the state of Karnataka. The major crops from this district are Paddy, Jowar, Cotton, Maize, Pulses, Red gram, Green gram, Black gram, Bengal gram, Chilli, Ground Nut, Ajwain or Thymol, Sugarcane, Turmeric and vegetables. Tandur area is famous for Red gram (Pigeon pea) production and many toor dal mills located in and around town and the dal from area created its own brand name as Tandur Pappu. The forest cover is of Tropical Dry Deciduous type. The climate of the area is characterized by a hot summer and generally a dry weather, except during South-West monsoon season. The average annual rainfall is about 960mm.

Sample collection
Eight squeezed honey samples of *Apis florea* combs collected during summer(Mar-May) 2021 from eight localities (Kompally, Pathur, Kamareddygudem, Girigetpally, Athvelly, Kothagadi, Madlapally, Mothkapalli) of Vikarabad district, Telangana state (Map-1 and Table-1) and were palynologically analysed. The samples originated from in and around the agricultural tracts and the surrounding areas of the study localities. For the recovery, analysis and quantification of the pollen, the methodology recommended by International Commission for Bee Botany (Louveaux *et al*., 1978) was followed. Pollen slides were prepared by using Acetolysis technique

(Erdtman, 1960). The pollen types recovered were identified based on pollen morphological characters and referring to standard literature. The recorded pollen types were quantified and placed under four pollen frequency classes.(I.C.B.B.,1978). Predominant pollen type(> 45% of the total pollen count),Secondary pollen type (16-45%), Important pollen type (3-15%), Minor pollen type (<3%).

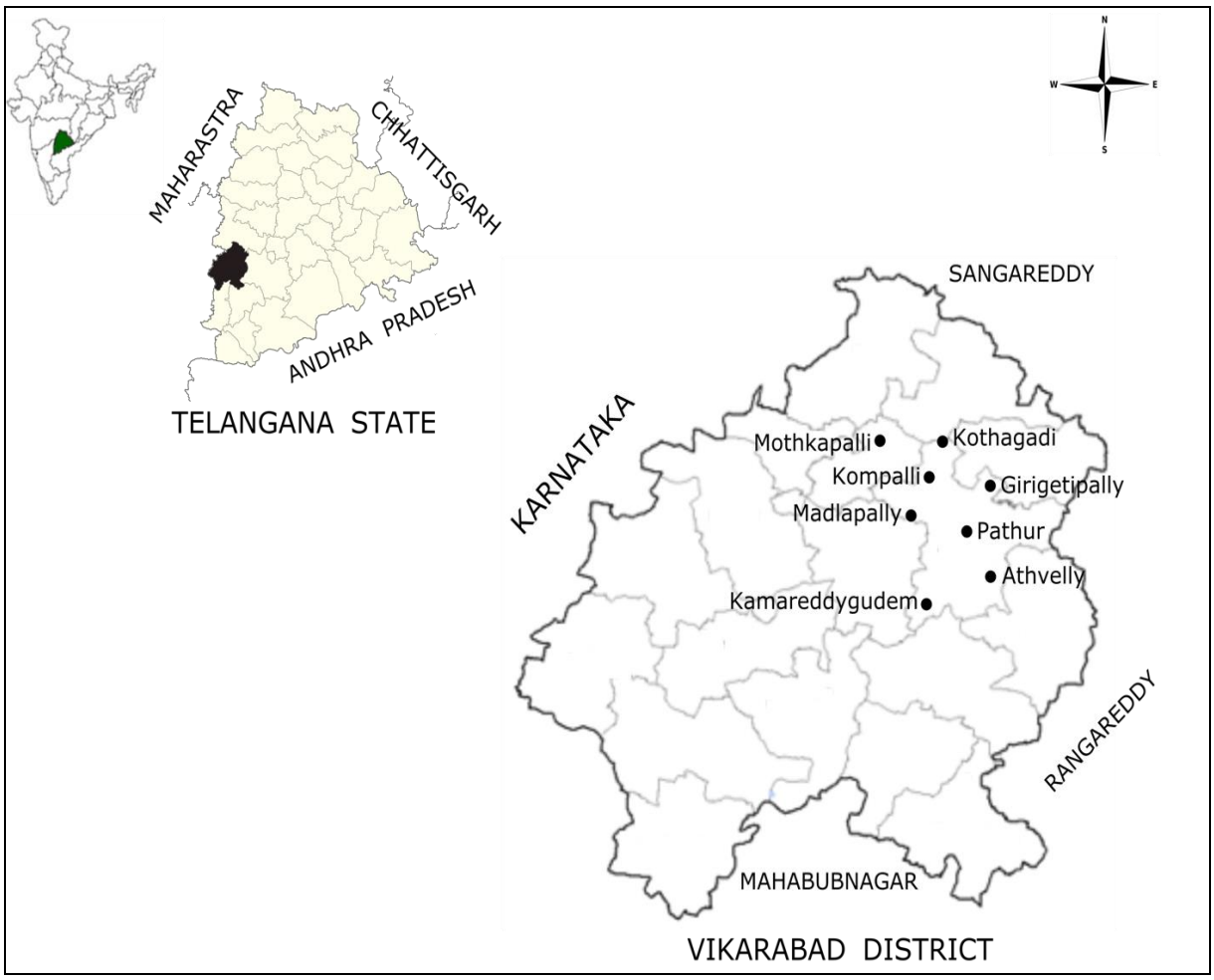


Fig 1: Showing localities of Vikarabad district from where honey samples were collected.

Table 1: Inventory of honey samples collected from Vikarabad district of Telangana State.

S. No	Sample Code	Village	Date of Collection	Colour of The Honey
1	VVK-Af-1	Kompalli	14/03/2021	Amber
2	VVP-Af-2	Pathur	16/04/2021	Amber
3	VVK-Af-3	Kamareddygudem	18/04/2021	Amber
4	VVG-Af-4	Girigetipally	28/03/2021	Amber
5	VVA-Af-5	Athvelly	26/04/2021	Amer
6	VVKo-Af-6	Kothagadi	14/03/2021	Yellow
7	VVM-Af-7	Madlapally	11/04/2021	Dark Amber
8	VVMo-Af-8	Mothkapalli	26/05/2021	Amber

Results

Of the eight samples studied, seven samples were found to be unifloral/monofloral and one multifloral. Pollen types of *Alternanthera sessiles* (VVK-Af-1, VVA-Af-5), *Carum copticum*(VVG-Af-4, VVMo-Af-8), *Ageratum conyzoides* (VVP-Af-2, VVM-Af-7) in two samples each *and Sphaeranthus indicus* (VVK-Af-3) in one sample were recorded in predominant (.>45%) condition in the unifloral samples studied. The secondary (16-45%) pollen types are *Carum copticum Sphaeranthus indicus and Alternanthera sessiles*. Eight pollen types in important minor (3-15%) and twenty five pollen types in minor (<3%) category were recorded in the present study. Grass and *Zea mays* are the pollen types of non-melliferous / anemophilous taxa recorded in negligible percentages.

Table- 2 provides detailed information of all the pollen types recorded in predominant, secondary, important minor and minor category. The characteristic pollen types of the bee plants recorded from the honey samples of the present study are illustrated in plate 1 and 2.

Table 2: Frequency classes and frequencies (%) of pollen types recorded

VVK-Af-1 (Kompalli village) Unifloral	P - *Alternanthera sessiles*: 72%, S - Nil, IM- *Carum copticum*: 12.3%, *Sphaeranthus indicus*: 6%, *Cajanus cajan*: 3%, M- *Ageratum conyzoides*: 2.5%, *Tinospora cordifolia*: 2%, *Tridax procumbens*: 1.6%, *Terminalia arjuna: 0.16%, Chenopodium album*: 0.12%, Psidium guajava: 0.08%, *Aspidopterys indica:0.08%, Justicia procumbens: 0.08% NMP: Grass pollen:0.12%*
VVP-Af-2 (Pathur) Unifloral	P - *Ageratum conyoides: 48%,* S - *Carum copticum: 36%* IM - *Tridax procumbens:12%,* M - *Alternanthera sessiles: 2% Leucaena leucocephala:1.2%, Ricinus communis: 0.08% Tinospora cordifolia: 0.08% NMP: Zea mays:0.6%*
VVK-Af-3 (Kamareddygudem) Unifloral	P - *Sphaeranthus indicus: 96%,* S - Nil, IM - Nil,, M - *Carum copticum: 2.6%, Leucaena leucocephala: 0.53%, Alternanthera sessiles: 0.51%, Tinospora cordifolia: 0.33%, Cajanus cajan: 0.33%, Ricinus communis: 0.08%, Carthamus tinctorius:0.08%*
VVG-Af-4 (Girigetipally) Unifloral	P - *Carum copticum: 92%,* S - Nil, IM - *Ageratum conyoides: 4%,* M - *Tinospora cordifolia: 2%, Psidium guajava: 1.4%, Cajanus cajan: 0.6%, Chenopodium album:0.08%*
VVA-Af-5 (Athvelly) Unifloral	P - *Alternanthera sessiles: 54%,* S - Nil, IM - *Ageratum conyoides: 12.5%, Carum copticum: 10.5%, Cajanus cajan: 8%, Sphaeranthus indicus: 9%,* M - *Tinospora cordifolia: 2%, Eucalyptus globulus: 2%, Tridax procumbens: 1%, Celosia arjentea: 1%*
VVKo-Af-6 (Kothagadi) Multifloral	P - Nil, S - *Alternanthera sessiles: 40%, Carum copticum: 24%,* IM - *Leucaena leucocephala: 11%, Cajanus cajan: 9%, Eucalyptus globulus: 8%,* M - *Lannea coromandelica: 2.5% Grewis sp: 2%, Tridax procumbens:0.16%, Terminalia sp: 1.8%, Bassia latifolia: 1.2%, Ricinus communis: 0.33%, Spinacea oleracea: 0.08%, Ageratum conyoides: 0.08%, Launea pinnatifida:0.08%, Celosia argentea: 0.08%, Chenopodium album: 0.08%*
VVM-Af-7 (Madlapally) Unifloral	P - *Ageratum conyzoides: 88%* S - Nil, IM - *Alternanthera sessiles: 7%,* M - *Carum copticum: 1.4%, Mangifera indica: 1.3% Spinacea oleracea: 1.3%, Tridax procumbens: 0.5%, Prosopis juliflora: 0.5%*
VVMo-Af-8 (Mothkapalli) Unifloral	P - *Carum copticum: 76%,* S - *Sphaeranthus indicus: 20%,* IM - Nil, M - *Cajanus cajan: 2.1%, Ricinus communis: 1.38%, Tinospora cordifolia: 0.16%, Celosia arjentea: 0.12%, Tridax procumbens:0,08%, Brassica nigra:0.08%, Rungia repens: 0.08%*

Discussions

Pollen analysis of eight honey samples of *Apis florea* was carried out which resulted in the recognition of seven unifloral and one multifloral honey. Unifloral nature of the honeys is because of the presence of a predominant pollen type in >45%. Pollen types of *Carum copticum, Alternanthera sessiles, Ageratum conyzoides* in two samples each *and Sphaeranthus indicus* in one sample were recorded in predominant condition in the unifloral samples studied The other noteworthy pollen types which constitute for alternate source of nectar include *Cajanus cajan, Tinospora cordifolia, Tridax procumbens, Eucalyptus globulus, Ricinus communis, Leucaena leucocephala, Psidium guajava, Celosia argentea, Chenopodium album, Bassia latifolia etc.* Altogether 26 pollen types referable to 16 families were recorded in the present study. *Carum copticum, Ageratum conyzoides, Alternanthera sessiles, Cajanus cajan, Sphaeranthus indicus, Tinospora cordifolia Ricinus communis* and *Tridax procumbens* pollen types were very frequently recorded in the samples studied. *Carum copticum* (Ajwain) pollen recorded from all the samples. It is pertaining to note that pollen of major crop plants of the area like *Carum copticum, Cajanus cajan*, showed their frequency and dominance in the samples studied. Most of the pollen types recorded in the present study were earlier recorded from honey samples of Medak (Chaya and Varma, 2004, 2008, 2010) [1, 2, 3] Nizamabad (Ramakrishna and Bhushan, 2004) [8], districts. Earlier Kalpana and Ramanujam 1994, recorded Carum copticum as a major nectar source species for the honey bees from Rangareddy district of Telangana state. The occurrence of Carum copticum may be attributed to its widespread distribution of this crop and is cultivated for its condimental seeds and medicinal importance. Similar studies on pollen analysis of honey samples from two coastal districts of Orissa was carried out by Debasis *et al*., 2014 and highlighted the sustainability of their study area for establishing moderate to large scale apicultural entrepreneurship. Vibhasa Shukla and Kottapalli S. Rao 2021 [9] studied the summer honeys samples from Prayagraj District, Uttar Pradesh, India and identified the bee flora and also observed that Prayagraj district has good potential for beekeeping ventures, due to the high diversity of nectar and pollen producing taxa. Pollen diversity recorded from the honey samples of Vikarabad district indicate the presence of considerable bee forage

plants in the area for honey production. The bee flora highlighted in the present study can be utilized in beekeeping activities which will improve the socio-economic status of the people of this region and further studies are needed for coming to any meaning conclusions.

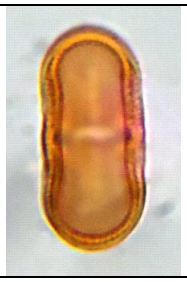
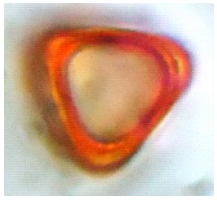
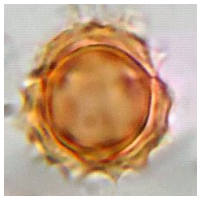
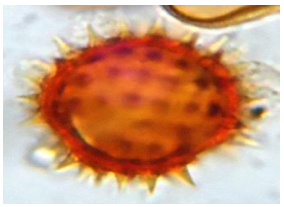
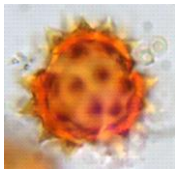
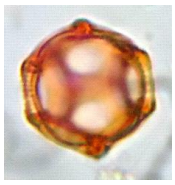
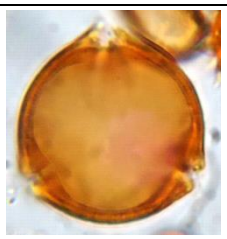
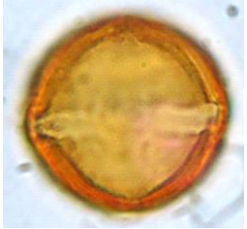
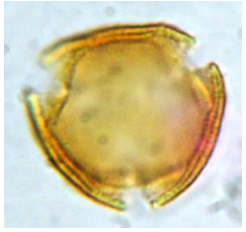
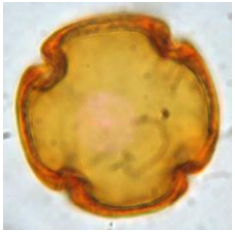
			
***Carum copticum* E.V**	***Carum copticum* P.V**	***Ageratum conyzoides***	***Tridax procumbens***
			
***Cajanus cajan* E.V**	***Cajanus cajan* E.V**	***Sphaeranthus indicus***	***Eucalyptus globulus***
			
***Cajanus cajan* P.V**	***Cajanus cajan* P.V**	***Lennea coromandelica***	***Lannea coromandelica***
			
Alternanthera sessiles	***Alternanthera sessiles***	***Tinospora cordifolia* P.V**	***Tinospora cordifolia* E.V**

Plate 1: Photomicrographs of the pollen types recorded. (All figures X1000 magnification)

			
Ricinus communis	***Ricinus communis***	***Ricinus communis***	***Rungia repens***
			
Mangifera indica	***Mangifera indica***	***Bassia latifolia***	***Bassia latifolia***

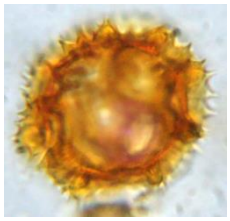
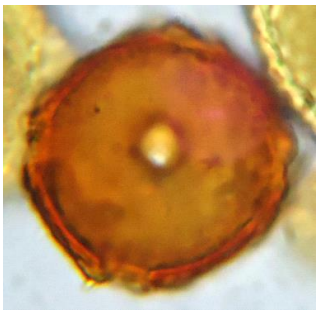
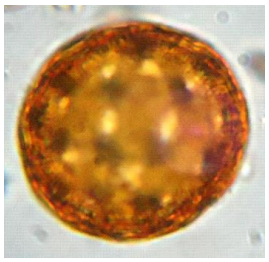
			
Sonchus Sp.	***Grewia sp.***	***Aspidopterys indica***	***Spinacea oleracea***
			
Grass pollen	***Zea mays***	***Chenopodium album***	***Celosia argentea***

Plate 2

Conclusions

Pollen analysis of eight honey samples of *Apis florea* was carried out which resulted in the recognition of seven unifloral and one multifloral honey. *Alternanthera sessiles, Sphaeranthus indicus, Carum copticum, and Ageratum conyzoides* pollen types were recorded in predominant condition in the unifloral samples studied. Altogether 26 pollen types referable to 16 families were recorded. The bee flora recorded can be utilized in beekeeping activities.

Acknowledgments

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