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Pollen analysis of squeezed honeys from Umrer tahsil of Nagpur Dist., Maharashtra Sate (India) and its relevance to apiculture.

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ABSTRACT:

Twenty two honey samples of *Apis dorsata* were collected from eight villages of Umrer Tahsil of Nagpur district., Maharashtra State during the period October 2005 to April 2007. Of the 22honey samples, 11 represented winter honeys collected during October 2005 to February 2007 while the rest summer honeys from March 2005 to April 2007. All winter honey samples were found to be unifloral for *Capsicum annuum*. The percentage of *Capsicum* Pollen ranged from 64.48% to 74.60%. The other frequent to less frequent pollen types encountered in these honeys are viz., *Helianthus annuus, Sphaeranthus indicus, Tridax procumbens, Hyptis suaveolens, Lagascea mollis, Carthamus tinctorius* and *Sonchus oleraceus*. Honeydew elements were 'practically none' in the *Capsicum* honey. Of the eleven summer honey samples nine were found to be unifloral and other two multifloral. *Syzygium cumini* formed the predominant pollen type in five samples. Its percentage ranged from 49.94% to 61.35%. *Mangifera indica* (60.73%) formed the predominant pollen type in the two samples while that of *Helianthus annuus* (52.16%) in other two honey samples. In the multifloral honeys, *Helianthus annuus* and *Syzygium cumini* constituted the secondary pollen types. The other frequent to less frequent pollen types encountered in these honey are viz., *Prosopis juliflora, Blumea* sp., *Capsicum annuum, Parthenium hysterophorus, Sphaeranthus indicus, Sonchus oleraceus* and *Clerodendrum* sp. The honeydew elements were 'practically none' in these samples.

Keywords: Umrer Tahsil, unifloral, Pollen, mutifloral.

INTRODUCTION:

Beekeeping or Apiculture, essentially based upon the intimate and reciprocal relationships between honey bees and plants. It is a productive and profitable cottage industry which provides self employment to a large number of people living in rural and forest areas. Beekeeping activity can be pursued

only in such regions where bee flora is available either naturally or by means of propogation. Therefore, identification of bee flora and their propogation through afforestation and reforestation programmes help in improving the bee forage wealth and concomittantly the efficacy of beekeeping industry and commercial honey production.

As natural(wild) combs of ***Apis dorsata*** (Giant bee) are found aplenty in and around the agricultural tracts and forest environs of Umrer tahsil, it was felt that a detailed melittopalynological study of ***Apis dorsata*** honeys seasonally, could be undertaken which would help in the recognition of unifloral and multifloral honeys and identifying areas with abundant nectar and pollen source and thereby assessing the suitability and relative potential of various villages of this tahsil for beekeeping industry.

Information thus obtained would be of extreme utilitarian value in apiculture with the bee hive colonies of ***Apis cerana*** for the commercial production of honey.

The present contribution documents a critical study of the pollen analysis of ***Apis dorsata*** honeys of Umrer tahsil of Nagpur district and attempts to highlight the significance of bee forage plants in apiculture and social forestry programmes.

MATERIALS AND METHODS:

Twenty two honey samples were collected from eight villages of Umrer tahsil of Nagpur district, Maharashtra state, during the period October 2005 to April 2007. All these samples represent squeezed honey obtained from the honey combs of ***Apis dorsata*** . The squeezing of the honey combs, however was carried out under personal supervision. Enough care was taken to see that only the honey storing portion was pressed for the removal of honey. The

villages from which the honey samples were collected include, Udasa (3 samples, NGP- UM- Uda- 1, NGP –UM- Uda- 15, NGP –UM- Uda- 21) from Udasa village, Wirli (6 Samples – NGP –UM- Wir – 2, NGP –UM- Wir – 3, NGP – UM- Wir – 11, NGP –UM- Wir – 12, NGP –UM- Wir – 16, NGP –UM- Wir – 20) from Wirli village, Rajulwadi (3 – samples, NGP- UM- Raj – 4, NGP- UM- Raj – 5, NGP- UM- Raj – 17) from Rajulwadi village, Ghoturli (4 samples, NGP- UM- Gho – 6, NGP- UM- Gho – 7, NGP- UM- Gho – 13, NGP- UM- Gho – 22) from Ghoturli village, Borgaon (2 samples, NGP- UM- Bor- 9 and NGP- UM- Bor- 18) from Borgaon Village, Hewati (2 samples NGP- UM – Hew -10 and NGP- UM - Hew -19) from Hewati village, Thomra (1 samples NGP-UM-Tho- 8) from Thomra Village, Hetee(1 samples NGP-UM- Het- 14) from Hetee village. (See map).

Of the 22 honey samples, 11 represented winter honeys (1,2,3,4,5,6,7,14,15,16,and 17) collected during the period October 2005 to February 2007 while the rest summer honeys (8,9,10,11,12, 13, 18, 19,20, 21 and 22) from March 2005 to April 2007.

1 ml of honey sample was dissolved in 10 ml of distilled water and centrifuged. The resultant sediment was treated with 5 ml glacial acetic acid. After decanting the acetic acid, the sediment was subjected to acetolysis (Eardtman 1960). Three pollen slides were prepared for each sample and were scanned critically. Reference slides of pollen types of the local flora and relevant literature were made use of in indentifying the pollen grains recovered. For determining the pollen frequency classes 300 pollen grains (100 per slide) were counted (Louveaux *et al.*, 1978). After quantifying, the pollen grains were placed under the following four pollen frequency classes viz ; Predominant pollen type (> 45 %), Secondary pollen types (16 – 45 %), Important minor pollen types (3 -15 %) and Minor pollen types (<3 %). Honey with predominant pollen type represents unifloral honey. Based on their

individual frequencies, the pollen grains were categorized as very frequent (>45 %) , Frequent (16 – 45 %) , Rare (3 -15 %) and Sporadic (< 3 %) .

Honeydew elements (fungal spores, hyphal shreds and algal filaments) were studied from unacetolysed honey samples and HDE/P ratio was determined in accordance with Louveaux *et al.* (1978)

For obtaining the absolute pollen counts of the samples the method recommended by Suryanarayana *et al.* (1981) was used . Pollen spectra and palynagraphs were provided for each honey sample based on their pollen frequencies (Figs. 1 to 22).

OBSERVATIONS:

Analysis of winter honeys :-

Capsicum annuum constitutes the predominant pollen type in all the eleven samples studied which accordingly may be designated as ***Capsicum*** honeys. Its percentage ranged from 64.48 (NGP –UM- Uda – 1 & 15) to 74.60 % (NGP –UM- Raj – 4 & 17). ***Tridax procumbens*** represents the secondary pollen type of the samples NGP –UM- Uda – 1, NGP –UM- Wir – 2, NGP –UM- Uda – 15, and NGP –UM- Wir – 16 while the samples NGP –UM- Gho – 7 and NGP –UM- Het – 14 had ***Helianthus annuus*** and ***Sphaeranthus indicus*** as the secondary pollen types respectively. In the rest of the samples secondary pollen types were not recorded. Important minor and minor pollen types were encountered in all the samples.

Altogether 28 pollen types (25 of melliferous and 3 of non-melliferous plants Amaranthus / Achyranthes sp., ***Sorghum vulgare*** and ***Zea mays***) referable to 12 families have been recorded in the samples studied. The significant pollen types found in association with the pollen of ***Capsicum annuum*** are viz., ***Tridax procumbens***, ***Hyptis suaveolens***, ***Sphaeranthus indicus, Lagascea mollis, Carthamus tinctorius*** and ***Sonchus oleraceus.***

Information pertaining to the pollen types in the honey samples studied and their frequency class is represented in Table 1. Table 2 provides information regarding the frequencies of individual pollen grains of each honey sample. It may be noted that anemophilous (non- melliferous) pollen grains were excluded while determining the frequency classes and frequencies of the entomophilous (melliferous) pollen grains

(Louveaux *et al.*, 1978)

Capsicum annuum was found to be above 70% in six honey samples viz :, NGP – UM- Wir – 2, (70.73 %) NGP – UM- Raj –4, (74.60%), NGP –UM Raj- 5 (74.32 %) NGP – UM- Gho – 6 (74.33%), NGP – UM- Wir –16 (70.73%) and NGP – UM- Raj –17 (74.60%) collected from Wirli, Rajulwadi & Ghoturli villages respectively. Despite having the same predominant pollen type of the ***Capsicum annuum***, the eleven honey samples under investigation show differences with reference to the number and frequency values of their associated pollen types. These differences find their true expression in the varied designs of the palynographs of the honey samples (Figs. 1,2,3,4,5,6,7,14,15,16 & 17). Honey samples with less number of pollen types viz., NGP – UM- Wir – 2 and NGP – UM- Wir – 16 show highly characteristic designs offer weired nature (Figs. 2 & 16) when compared to those with relatively higher number of pollen types.

The sample NGP – UM – Wir - 3 (from Wirli Village) showed maximum number of pollen types (15) and families (9), while the samples NGP – UM – Wir - 2 and NGP – UM – Wir – 16 (both from Wirli village) had minium number of pollen types (6) each & families (4). Photoplate shows the photomicrographs of pollen types recorded in the present study.

In all the honey samples studied honeydew elements (HDE) represented by fungal spores viz., Microsporum, Heliminthosporium & Curvularia and hyphal shreds were very few and the ratios HDE/P, where P represents the

total frequency of pollen grains from nectar- producing plants ranged from 0.01 to 0.05. The honeydew elements are thus referable to the category 'practically none' (Louveaux *et al.* 1978)

Air borne (anemophilous) pollen grains:

Sorghum vulgare, Amranthus /Achyranthes sp. and the ***Zea mays*** are the air borne pollen grains recorded from the honey samples. ***Sorghum vulgare*** was encountered in the samples NGP-UM-Wir -2 , NGP-UM-Wir -3, NGP-UM-Raj-4, NGP-UM-Gho-7, NGP-UM-Wir- 16 and NGP-UM-Raj-17 and Amaranthus/ Achyranthes sp. in NGP-UM-Raj- 5 & NGP-UM-Gho -7 While ***Zea mays*** was encountered in the samples NGP-UM-Uda-1 and NGP-UM-Uda-15. The percentage of ***Sorghurn vulgare*** ranged from 0.33% (NGP-UM-Wir-2,3 & 16) to 11.83 % (NGP-UM-Gho-7) while that of ***Zea mays*** 0.5 % (NGP-UM-Uda-1 & 15). The percentage of Amaranthus / Achynanthes sp. was 0.66 % in sample 5 & 0.18% in sample 7. ***Sorghum vulgare*** (0.33 to 11.83 %) was recovered as important minor and minor pollen type while that of ***Zea mays*** (0.5 %) and Amarathus and Achyranthes sp. (0.18 % to 0.66 %) as minor pollen type.

Except ***Sorghum vulgare*** in sample NGP-UM-Gho – 7, the rest of the air borne pollen types were encountered in very low frequencies in our honey samples and may have been deposited in the honey storing region of the comb as contaminants through air or inadevertently by the bees themselves. The somewhat high percentage (11.83 %) of the pollen of ***Sorghum vulgare*** in the honey sample NGP-UM-Gho- 7 because of accidental mixing up of some of this pollen from the pollen storing cells of the comb with the honey during squeezing process.

The absolute pollen counts of the samples analysed were found to range from 85000/g (NGP-UM-Wir- 2) to 1265,000/g (NGP-UM-Gho- 7), the details of which are provided in table 2 .

Analysis of summer honeys :-

Of the 11honey samples collected from different villages of Umrer tahsil, nine were found to be unifloral (NGP-UM-Tho -8, NGP-UM-Bor – 9, NGP-UM-Hew -10, NGP-UM-Wir-11, NGP-UM-Gho-13, NGP-UM-Bor-18, NGP-UM-Hew-19, NGP-UM-Wir-20 and NGP-UM-Gho-22) and other two multifloral (NGP-UM-Wir-12 and NGP-UM-Uda-21). (Table 2).

Syzygium Cumini formed the predominant pollen type in five samples (NGP-UM-Tho-8, NGP-UM—Bor – 9 , NGP-UM-Hew- 10, NGP-UM-Bor -18 and NGP-UM-Hew- 19). Its percentage ranged from 49.94 % (NGP-UM-Hew -10 &19)to 61.35% (NGP – UM – Bor. 9 & 18).

Mangifera Indica (60.73%) formed the predominant pollen type in two samples (NGP-UM-Wir-11 and NGP-UM-Wir -20) while that of ***Helianthus annuus*** (52.16 %) in two (NGP-UM-Gho-13 and NGP-UM- Gho -22). The samples 8, 9 and 18 had no secondary pollen types. In the multifloral honeys ***Helianthus annuus*** and ***Syzygium cumini*** constituted the secondary pollen types. Important minor and minor pollen types were encountered in all the honey samples.

Altogether 25 pollen types (23 of melliferous and 2 of non-melliferous plants) referable to 16 families have been recorded in the samples studied. The other significant pollen types (up-to important minor) recorded were viz., ***Prosopis juliflora, Blumea*** sp. ***Capsicum annuum***, ***Parthenium hysterophorus***, ***Sphaeranthus indicus, Sonchus oleraceus & Clerodendrum*** sp.

Information pertaining to the pollen types in the honey samples studied and their frequency class is represented in Table 1. Table 2 provides information regarding the frequencies of individual pollen grains of each honey sample. It may be noted that anemophilous (non-melliferous). Pollen grains were excluded

while determining the frequency classes and frequencies of the entomophilous (melliferous) pollen grains (Louveaux *et al.*, 1978).

Under investigation it has been observed that, the honey samples show differences with reference to the number and frequency values of their associated pollen types. These differences find their due expression in the varied designs of the palynographs of the honey samples (Figs. 8,9,10,11,12,13,18,19,20,21 & 22). The sample 10 (NGP-UM-Hew- 10) with less number of pollen types shows highly characteristic designs after weired nature (Fig. - 10) when compared to those with relatively higher number of pollen types.

The sample NGP-UM-Hew-19 showed minimum number of pollen types (10) and while the Sample NGP-UM-Tho -8 (from Thomra village) had maximum number of pollen types (19). Figs. 8,9,10,11,12,13,18,19,20,21 & 22 are the photomicrographs of the pollen types recorded in the present study.

In all the honey samples studied honeydew elements (HDE) represented by fungal spores viz; Microsporum, Helminthosporium and Curvularia and hyphal shreds were very few and the ratios HDE/P where P represents the total frequency of pollen grains from nectar- producing plants, ranged from 0.01 to 0.02. The honey-dew elements are thus referable to the category 'practically none' (Louveaux *et al.*, 1978).

Air – borne (anemophilous) pollen grains :-

Typha angustata and ***Sorghum vulgare*** are the air-borne pollen grains recorded from the honey samples under study. ***Typha angustata*** was recorded in all the honey samples while ***Sorghum vulgare*** in the two samples NGP-UM-Tho- 8 & NGP-UM-Hew-10. The percentage of ***Typha angustata*** ranged from 0.33% (NGP-UM-Tho-8) to 32.5% (NGP–UM-Bor-9 & 18) while that of ***Sorghum vulgare*** 0.08% (NGP-UM-Tho-8 & NGP-UM-Hew-10.) ***Typha***

angnstata (0.33% to 32.5%) was recovered as secondary, important minor and minor pollen type while that of ***Sorghurn vulgare*** (0.08%) as minor pollen type.

The absolute pollen counts of the samples analysed were found to range from 55,000/g(NGP-UM-Tho-8) to 173,000/g (NGP-UM-Hew-10, NGP-UM-Wir-20, and NGP-UM-Gho -22), the details of which are provided in table 2 .

DISCUSSION :

The present study incorporating a comprehehensive qualitative and quantitative analysis of pollen contents of 22 honey sample of ***Apis dorsata*** honeys collected during winter & summer seasons from different villages of Umrer tahsil of Nagpur district brought to light a number of bee forage plants serving as major or minor nectar and or pollen sources for honey bees in this tahsil. A total of 42 pollen types (38 melliferous and 4 non-melliferous / anemo-philous taxa) referable to 21 families are recorded form honeys.

Analysis of honey sample.

Winter honeys :-

A detailed analysis of the pollen contents of eleven honey samples of ***Apis dorsata*** collected during the period October to January from five villages of Umrer tahsil, viz Udasa , Wirli , Rejulwadi , Ghoturli and Hetee has unraveled the uniflioral nature of all the honeys with ***Capsicum annuum*** or the predominant pollen type and thereby highlighted the importance of this plant as a major and reliable nectar source for the honey bees during the above period. ***Capsicum annuum*** flowers almost round the year but the farmers of this region grow the crop during this period representing its peak flowering period. The other winter crops of this tahsil like ***Coriandrum sativum, Helianthus annuns, Carthamus tinctorius*** and ***Cojanus cajan*** start

blossoming on a large scale. ***Capsicum annuum*** would be available in full bloom for the supply of nectar in abundance to honey bees.

The appreciably high percentage of the pollen of ***Capsium annuum*** in various honey samples leading to the virtual elimination of the pollen of other plants bears sample testimony for the above contention which incidentally also finds its expression in the pollen spectra and palynographs of the honeys. The other frequent to less frequent pollen types of melliferous plants encountered in the honeys under investigation are those of ***Tridax procumbens, Hyptis suaveolens, Sphaeranthus indicus, Lagascea mollis, Helianthus annuus, Celosia argentea, Leucaena leucocephala, Parthenium hysterophorus, Tinospora cordifolia, Justicia procumbens, Cajanus cajan, Mimosa*** sp., ***Carthamus tinctorius, Alternanthera sessilis, Vernonia cineria, Ocimum basilicum, Delonix regia, Bidens pilosa, Bombax ceiba, Coriandrum sativum, Rungia repens, Ageratum conyzoides*** and ***Alysicarpus rugosus***. It is therefore suggested that all such areas where ***Capsicum annuum*** is seen extensively in great concentration may be earmarked as highly suitable areas for apiculture; particularly during the period September to December and the bee-Keepers be accordingly advised to install colonies of ***Apis cerana*** at these places.

Summer Honeys :-

Pollen analysis of eleven honey samples of ***Apis dorsata*** collected during the period March to April from six villages of Umrer tahsil, viz., Thomra, Borgaon , Hewati, Wirli, Ghoturli and Udasa has brought to light that out of eleven honey samples nine were found to be unifloral and other two multifloral. ***Syzygium cumini*** formed the predominant pollen type in five samples while that of ***Mangifera indica*** and ***Helianthus annuus*** in two samples each. This indicats that ***syzygium cumini***, ***Helianthus annuus*** and ***Mangifera indica*** represent the major and reliable nectar sources for honey bees during above

period. ***Syzygium cumini*** and ***Mangifera indica*** flower from January to May while that of ***Helianthus annuus*** from November to February. During this period ***Syzygium cumini, Helianthus annuus*** and ***Mangifera indica*** would be available in full bloom for the supply of nectar in abundance to the honey bees.

The appreciably high percentage of the pollen of ***Syzygium cumini, Mangifera indica*** and ***Helianthus annuus*** leading to the virtual elimination of the pollen of other plants bears ample testimony for the above contention , which incidentally also finds its expression in the pollen spectra & palynographs of the honeys. The other frequent to less frequent pollen types of melliferous plants encountered in the honeys under investigation are those of ***Prosopis julifiora, Blumea*** sp., ***Sonchus oleraceus, Terminalia*** sp., ***Alangium salvifolium, Parthenium hysterophorus, Carthamus tinctorius, Capsicum annuum, Bombax ceiba , Azadirachta indica, Pongamia, pinnata, Albizia lebbeck, Cajanus cajan, Leucaena leucocephala, Asteracantha longifolia, Vernonia cinerea, Careya arborea, Clerodendrum*** sp. & ***Echinops echinatus***. It is therefore suggested that all such . areas where ***Syzygium cumini, Mangifera indica*** and ***Helianthus annuus*** are seen extensively in great concentration may be earmarked as highly suitable areas for apiculture particularly during the period March to April and the beekeepers be accordingly advised to install colonies of ***Apis cerana*** at these places.

In the multifloral honeys ***Helianthus annuus*** and ***Syzygium cumini*** constituted the secondary pollen types too.

Bee forage plants and social forestry :-

One of the aims of the present study is to explore the feasibility of associating the bee- keeping enterprise with the social forestry programmes which invariably are designated to promote employment avenues and augment the meager financial resources of the marginal farmers in rural areas.

Melittopalynological research facilitates recognition and evaluation of the myriad plants utilized in social forestry for their nectar and pollen supply to the honey bees. In this context, our study has refreshingly brought to light that ***Prosopis juliflora*** and ***Leucaena leucocephala*** the accredited social forestry plants in Umrer tahsil, constitute significant and reliable sources of bee forage.

Accordingly, all such areas with extensive plantations of these bee plants, if selected for apicultural ventures and commercial honey production would fetch additional finances for farmers.

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Map-Location of study site, Umrer Tahsil (Nagpur District),

within Maharashtra State, India.