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Melissopalynological Determination of Pollen Density and Botanical Origin of Autumn Honeys of Kullu Hills, Himachal Pradesh, India

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ABSTRACT

Background: Geographical and botanical origins of honeys are determined by melissopalynological analysis. Pollen contents of 12 autumn honeys collected from Indian honey bee, *Apis cerana* F. hives located in different localities of Kullu hills of Himachal Pradesh were analysed. Kullu hills having varied geography, climatic condition with diversified and rich flora is ideal for apiculture. So, it is of utmost importance to study the floral richness of the area and preferences of honey bees for nectar and pollen in order to obtain maximum production of a good quality of honey. Thus, the present work was carried out to determine the critical analysis of honey samples and to identify the different pollen types which are major plant sources that contribute to the increase of yield of honey.

Methods: Melissopalynological studies were conducted between 2009 to 2012. Reference pollen slides of honey samples were prepared and identified. Quantative analysis is done with the help of a haemocytometer and pollen spectra, absolute pollen count as well as percentage of pollen types were calculated. Reference slides were also prepared.

Result: Microscopic analysis yielded that in honey samples, 5 pollen types were present as predominant; 17 were secondary, while, 38 were important minor and minor pollen sources. Out of 12 honey samples analysed, 5 were unifloral, whereas, 7 were multifloral. In the unifloral honeys, the predominant sporomorphs were: *Prunus cerasoides, Eriobotrya japonica*, *Prinsepia utilis, Plectranthus* sp. and *Solidago* sp. Forty four pollen types were necteriferous, while, 6 were nectarless represented by *Cannabis sativa, Juglans regia, Rumex nepalensis, Polygonum* sp. and *Zea mays*. Among different plant families, Lamiaceae (8), Asteraceae (7), Rosaceae (7), Fabaceae (4), Polygonaceae (3) and Apiaceae (2) highly contributed for nectar and pollen sources of honey bee. Twenty five botanical families with 50 different pollen taxa were identified indicating the various plants visited by honeybees and the sources of nectar used in the production of honey. The high concentration and diversity of pollen types showed that the samples were of botanical origin.

Key words: *A. cerana*, Autumn honey samples, Melissopalynology, Multifloral, Unifloral.

INTRODUCTION

Honey is a natural sweet, flavorful substance produced by honeybees from the nectar of blossoms, from secretion of living parts of plants. Honeybees collect it from nectaries, transform and combine it with specific substances of their own, store and leave in the honey comb to ripen and mature (White and Landis, 1980). Honey contains sugars, small quantities of proteins, enzymes, amino acids, minerals, trace elements, vitamins, aroma compounds and polyphones. It is widely accepted as a food source and medicine by both modern and ancient generations, traditions and civilizations (Allsop and Miller, 1996; Crane, 1975; Crane, 1999; Jones, 2001).

Honey flavor and variability of honey types depends upon the diversity of nectar sources present in the region. While, foraging for nectar honeybees also collect pollen with it. Nectar is a source of carbohydrates, whereas, pollen is the major source of proteins and amino acid for bee colonies (Tidke and Nagarkar, 2015). By studying the pollen in a sample of honey, it is possible to gain evidence of the geographical location by observing the honey samples for the presence of a combination of pollen that is typical only to that particular location (Louveaux *et al*., 1978). It is also possible to identify taxonomically the genera of the plants the honey bees visited, although honey may also contain airborne pollen from anemophilous plant species, spore and dust due to electrostatic charge of the worker bee. Information gained from a given honey sample is useful when substantiating claims of a particular honey source and is also of great importance for quality control and helps to ascertain whether honey is adulterated or not (Maurizio, 1951; Louveaux *et al*., 1978; Terrab *et al*., 2003).

Present investigations were conducted on honey samples collected from Indian hive bee, *Apis cerana* F.

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colonies located in different areas of Kullu hills of Himachal Pradesh. Kullu district is located between 31° 58′ 00″ North latitude and 77° 06′ 04″ East longitude. On the North and North-East, it is bounded by Lahaul-Spiti and Kangra districts, on the East and South-East by Kinnaur and Shimla districts. The total area of Kullu is 5,503 sq. km and the average altitude of district is 1,219 metres.

MATERIALS AND METHODS

In present investigations (field and laboratory studies were done as a part of Ph.D work during 2009 to 2012) twelve autumn honey samples were procured from domesticated Indian hive bee, *A. cerana* from different areas of Kullu hills of Himachal Pradesh so as to identify important pollen and nectar sources of this region (Table 1, Fig 1). Collection sites (and elevation in meters) are shown in Table 1. All honey samples collected were raw and unprocessed. The honey samples were subjected to Qualitative and Quantitative analysis. For Qualitative and Quantitative analysis, the methodology recommended by the International Commission for Bee Botany (ICBB) was followed (Louveaux *et al*., 1978) modified by (Iwama and Melhem, 1979). Identification of different pollen types was done with the help of standard works (Erdtman, 1960; Nair, 1964; Nair, 1985) and pollen slide collection of Sociobiology and Behavioral Ecology Research Lab, Department of Biosciences, Himachal Pradesh University, Shimla. For the preparation of pollen slides of honey, 10 gm of honey was dissolved in 20 ml of hot distilled water at 40°C. This solution was poured equally into different centrifuge tubes and centrifuged at 2500-3000 rpm for 10 min. The supernatant liquid was drained off with a fine pipette. The sediment was dispersed again and transferred into another centrifuge tube, centrifuged again for five minutes and sediment was separated. It was then acetolysed by adding sulphuric acid and acetic anhydride in ratio 1:9. The tube was then placed in a water bath for ten minutes at 70°C and centrifuged after incubation for five minutes. The centrifuge tube was filled with distilled water and a drop of strong detergent (teepol) was added. It was again centrifuged for five minutes and a drop of glycerine and water mixture (1:1) was added to the sediment. Then, this sediment solution was transferred to the slides which were placed in an oven (40-45°C) to get surplus water evaporated. The pollen grains were mounted in glycerine gelatin. Reference slides were prepared from the identified honey plants using Acetolysis Method and Glycerine Jelly Method (Louveaux *et al*., 1978).

Quantitative analysis is done with the help of a haemocytometer (Suryanarayana *et al*., 1981; Sharma, 1989). Pollen spectra, absolute pollen count as well as percentage of pollen types were calculated and formulated on the basis of these percentages (Sharma and Nair, 1965). The honey samples were categorized as rich, poor and extremely poor as per total number of pollen grains present in 10 gm of honey *i.e*., 1,00,000, 20,000 to 1,00,000 and below 20,000 respectively (Maurizio, 1975). The frequencies of pollen grains were recorded according to the system adopted by Louveaux *et al*., 1978: 'Predominant pollen' (>45% of the pollen grains counted); 'Secondary pollen' (16-45%); 'Important minor pollen' (3-15%) and 'Minor pollen' (<3%). Honey sample was termed as 'Unifloral honey' if it was having 45% or more grains of a single pollen type and honey sample' with several pollen types in considerable percentage was termed as 'Multifloral honey' (Chaturvedi, 1983; Sharma, 1989; Iwama and Melhem, 1979).

RESULTS AND DISCUSSION

During this study, 12 autumn honey samples produced in the Kullu hills were analyzed (Table 1, Fig 1). Fifty pollen types belonging to 25 different families were recognized in the quantitative analysis (Table 2 and 3; Fig 2 and 3-14). Five of the 12 samples analyzed were considered to be

Fig 1: Map showing different places of collection of autumn honey samples from Kullu district of Himachal Pradesh.

Table 1: Physiographic details of different places of collection of honey samples of *Apis cerana* F. from Kullu district of Himachal Pradesh.

Locality	Geographical position		Altitude (metres)
	Latitude (N)	Longitude (E)	
Larji[1]*	31°71′	77°21′	1013
Bajaura[2]	32°00′	77°29′	1065
Sarabai[3]	31°03′	77°09′	1086
Bhunter[4]	30°75′	77°25′	1107
Shogi[5]	30°75′	77°25′	1158
Garsa[6]	31°93′	77°11′	1176
Mohal[7]	30°75′	77°25′	1210
Sarvari[8]	31°61′	76°93′	1233
Katrain[9]	32°06′	77°08′	1481
Banjar[10]	31°61′	76°93′	1570
Patlikuhl[11]	30°75′	77°25′	1578
Bhekhli[12]	30°75′	77°25′	1775

Source: Collected through field work.

Table 2: Pollen spectrum of autumn honey samples of *Apis cerana* F. collected from Kullu hills of Himachal Pradesh.

Locality	Season	Colour of honey	Unifloral or multifloral	Predominant pollen type	Secondary pollen type	Important minor pollen type	Minor pollen type
1	2	3	4	5	6	7	8
Larji	Autumn	Yellow	Multifloral	-	*Cassia sp.*, *Taraxacum officinale* *Callistemon citrinus*	*Salvia* sp., *Adhatoda vasica*	*Cannabis sativa*, *Phoenix sylvestris*
Bajaura	Autumn	Brown	Multifloral	-	*Impatiens* sp., *Salvia splendens*	*Indigofera pulchella*, *Taraxacum officinale*, *Tilia* sp., *Aster* sp.	*Zea mays*, *Coriandrum sativum*
Sarabai	Autumn	Light brown	Multifloral	-	*Eriobotrya japonica*, *Fagopyrum sp.*	*Aesculus indica*, *Taraxacum officinale*, *Rumex nepalensis*, *Sesamum indicum*, *Prunus* sp.	*Vitis vinifera*, *Polygonum* sp.
Bhunter	Autumn	Creamish white	Unifloral	*Prunus cerasoides*	*Impatiens* sp.	*Aesculus indica*, *Ageratum conyzoides*, *Medicago* sp.	*Polygonum* sp., *Aster* sp.
Shogi	Autumn	Light brown	Multifloral	-	*Prunus* sp., *Eriobotrya japonica*, *Fagopyrum* sp.	*Brassica* sp., *Rubus* sp., *Coriandrum sativum*	*Sesam umindicum*, *Aster* sp.
Garsa	Autumn	Watery white	Unifloral	*Eriobotrya japonica*	*Salvia officinalis*, *Medicago* sp.	*Taraxacum officinale*	*Ocimum* sp., *Coriandrum sativum*, *Zea mays*
Mohal	Autumn	Brown	Unifloral	*Prinsepia utilis*	*Rubus ellipticus*, *Impatiens* sp.	*Medicago* sp., *Rumex nepalensis*, *Foeniculum vulgare*	*Ocimum basilicum.*, *Senecio* sp., *Aster* sp.
Sarvari	Autumn	Brown	Multifloral	-	*Aesculus indica*, *Impatiens* sp., *Brassica* sp.	*Adhatoda vasica*, *Rubus* sp., *Caesalpinia* sp.	*Rhus* sp., *Luffa cylindrica*
Katrain	Autumn	Light yellow	Multifloral	-	*Pyrus* sp., *Plectranthus coesta*	*Elaeagnus* sp., *Juglans regia*, *Ageratum conyzoides*, *Bidens pilosa*	*Sonchus asper*
Banjar	Autumn	Watery white	Multifloral	-	*Impatiens* sp., *Plectranthus gerardiana*, *Fagopyrum* sp.	*Solidago* sp., *Taraxacum officinale*, *Prinsepia utilis*	*Chenopodium album*, *Vitex negundo*
Patlikuhl	Autumn	Light brown	Unifloral	*Plectranthus* sp.	*Aesculus indica*	*Pyrus* sp., *Prinsepia utilis*, *Juglans regia*, *Foeniculum vulgare*	*Lonicera* sp., *Viola odorata*
Bhekli	Autumn	Light yellow	Unifloral	*Solidago* sp.	*Indigofera* sp., *Plectranthus* sp.	*Elaeagnus* sp.	*Salvia* sp., *Cannabis sativa*, *Rhus* sp.

Predominant pollen type = 45% and above; Important minor pollen type = 3 to 15%; Secondary pollen type = 16 to 45%; Minor pollen type = < 3%.

Table 3: Frequency distribution of pollen types in autumnhoney samples of *Apis cerana* F. collected from different areas of Kullu hills of Himachal Pradesh (expressed as percentage of total number of pollen grains).

Plant species	Larji	Bajaura	Sarabai	Bhunter	Shogi	Garsa	Piplage	Mohal	Sarvari	Katrain	Banjar	Patlikuhl	Bhekli
	1	2	3	4	5	6	7	8	9	10	11	12	13
Adhatoda sp.	5.77	-	-	-	-	-	-	-	8.3	-	-	-	-
Aesculus sp.	-	-	15.4	8.21	-	-	-	-	31.2	-	-	17.0	-
Ageratum sp.	-	-		6.20	-	-	-	-	-	5.12	-	-	-
Aster sp.	-	4.06	-	1.21	2.2	-	-	1.5	-	-	-	-	-
Bidens sp.	-	-	-	-	-	-	-	-	-	5.03	-	-	-
Brassica sp.	-	-	-	-	7.2	-	-	-	16.14	-	-	-	-
Caesalpinia sp.	-	-	-	-	-	-	-	-	3.28	-	-	-	-
Callistemon sp.	19.8	-	-	-	-	-	-	-	-	-	-	-	-
Cannabis sp.	2.5	-	-	-	-	-	-	-	-	-	-	-	1.43
Cassia sp.	40.9	-	-	-	-	-	-	-	-	-	-	-	-
Chenopodium sp.	-	-	-	-	-	-	-	-	-	-	2.26	-	-
Coriandrum sp.	-	1.17	-	-	6.7	2.03	-	-	-	-	-	-	-
Elaeagnus sp.	-	-	-	-	-	-	-	-	-	15.43	-	-	7.5
Eriobotrya sp.	-	-	28.0	-	27.3	47.14	-	-	-	-	-	-	-
Fagopyrum sp.	-	-	21.8	-	17.6	-	-	-	-	-	18.38	-	-
Foeniculum sp.	-	-	-	-	-	-	-	3.1	-	-	-	3.22	-
Impatiens sp.	-	40.32	-	16.02	-	-	-	15.9	30.9	-	30.21	-	-
Indigofera sp.	-	11.57	-	-	-	-	-	-	-	-	-	-	21.03
Juglans sp.	-	-	-	-	-	-	-	--	-	-	-	6.0	-
Lonicera sp.	-	-	-	-	-	-	-	-	-	-	-	2.13	-
Luffa sp.	-	-	-	-	-	-	-	-	1.0	-	-	-	-
Medicago sp.	-	-	-	5.51	-	17.43	-	9.4	-	-	-		-
Ocimum sp.	-	-	-	-	-	2.0	-	2.0	-	-	-	-	-
Phoenix sp.	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Plectranthus sp.	-	-	-	-	-	-	-	-	-	30.04	19.13	47.14	17.07
Polygonum sp.	-	-	2.0	2.0	-	-	-	-	-	-	-	-	-
Prinsepia sp.	-	-	-	-	-	-	-	-	-	-	-	10.03	-
Prunus sp.	-	-	7.6	61.21	29.1	-	-	-	-	-	-	-	-
Pyrus sp.	-	-	-	-	-	-	-	-	-	32.26	-	12.48	-
Rhus sp.	-	-	-	-	-	-	-	-	1.61	-	-	-	2.75
Rubus sp.	-	-	-	-	7.0	-	-	16.3	7.57	-	-	-	-
Rumex sp.	-	-	6.0	-	-	-	-	4.3	-	-	-	-	-
Salvia sp.	7.1	33.59		-	-	19.0	-	-	-	-	-	-	1.57
Senecio sp.	-	-	-	-	-	-	-	1.5	-	-	-	-	-
Sesamum sp.	-	-	4.0	-	2.9	-	-	-	-	-	-	-	-
Solidago sp.	-	-	-	-	-	-	-	-	-	-	10.84	-	48.65
Sonchus sp.	-	-	-	-	-	-	-	-	-	2.0		-	-
Taraxacum sp.	21.7	3.02	12.3	-	-	11.36	-	-	-	-	10.02	-	-
Tilia sp.	-	4.88	-	-	-	-	-	-	-	-	-	-	-
Viola sp.	-	-	-	-	-	-	-	-	-	-	-	2.0	-
Vitex sp.	-	-	-	-	-	-	-	-	-	-	2.0	-	-
Zea sp.	-	1.39	-	-	-	1.04	-	-	-	-	-	-	-

unifloral; *Prunus cerasoides* in Bhunter; *Eriobotrya japonica* in Garsa; *Prinsepia utilis* in Mohal; *Plectranthus* sp. in Patlikuhl and *Solidago* sp. in Bhekli were present as predominant sporomorphs. While, 17 pollen types were secondary sources and 38 were important minor and minor pollen sources. *Cassia* sp., *Taraxacum officinale Callistemon citrinus, Salvia splendens, Eriobotrya japonica, Fagopyrum* sp., *Impatiens* sp., *Prunus* sp., *Salvia officinalis, Medicago* sp., *Rubus ellipticus, Aesculus indica, Brassica* sp., *Pyrus* sp., *Plectranthus coesta* and *Plectranthus gerardiana* were

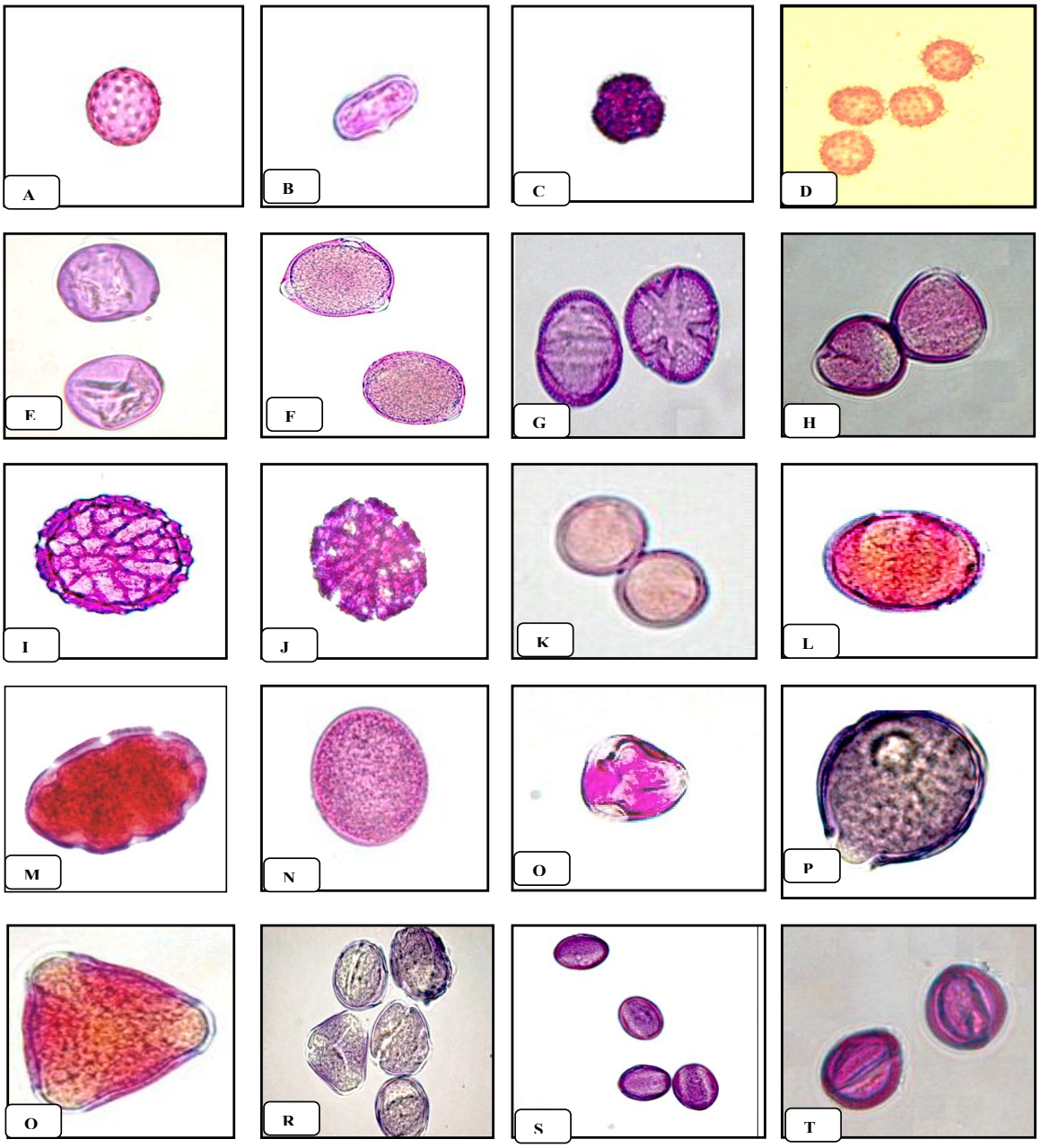

Fig 2: Showing distribution of pollen types in honey samples collected from different localities (altitudes) from Mandi district of Himachal Pradesh.

Pollen grains: A. *Chenopodium album* L. (Amaranthaceae), B. *Coriandrum sativum* L. (Apiaceae), C. *Ageratum conyzoides* L.(Asteraceae), D. *Solidago* sp. (Asteraceae), E. *Cannabis sativa* L. (Cannabinaceae), F. *Luffa cylindrica* (L.) Roem. (Cucurbitaceae), G. *Caesalpinia* sp. (Fabaceae), H. *Indigofera pulchella* Roxb. (Fabaceae), I. *Ocimum basilicum* L. (Lamiaceae), J. *Ocimum sanctum* L. (Lamiaceae), K. *Plectranthus coesta* Buch.-Ham. (Lamiaceae), L. *Plectranthus gerardianus* Wall. ex Benth. (Lamiaceae), M. *Salvia* sp. (Lamiaceae), N. *Zea mays* L. (Poaceae), O. *Eriobotrya japonica* Thunb. Lindley (Rosaceae), P. *Prinsepia utilis* Royle (Rosaceae), Q. *Prunus cerasoides* D. Don. (Rosaceae), R. *Pyrus* sp. (Rosaceae), S. *Aesculus indica* Colebr. (Sapindaceae), T. *Vitex negundo* L. (Verbenaceae).

the secondary pollen sources.Whereas, *Salvia* sp., *Adhatoda vasica, Cannabis sativa, Phoenix sylvestris, Zea mays, Coriandrum sativum, Indigofera pulchella*, *Tilia* sp., *Taraxacum officinale, Aesculus indica,Rumex nepalensis, Prunus* sp., *Sesamum indicum, Vitis vinifera, Polygonum* sp., *Ageratum conyzoides, Medicago* sp., *Aster* sp., *Brassica* sp., *Rubus* sp., *Ocimum* sp., *Foeniculum vulgare, Ocimum basilicum, Senecio* sp., *Caesalpinia* sp., *Rhus* sp., *Luffa cylindrica, Elaeagnus* sp., *Juglans regia, Bidens pilosa, Sonchus asper, Solidago* sp., *Prinsepia utilis, Chenopodium album, Vitex negundo, Pyrus* sp., *Lonicera* sp. and *Viola odorata* were important minor and minor pollen types.

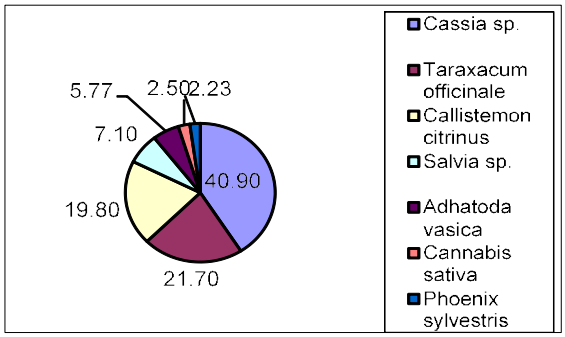

Fig 3: Larji-Multifloral.

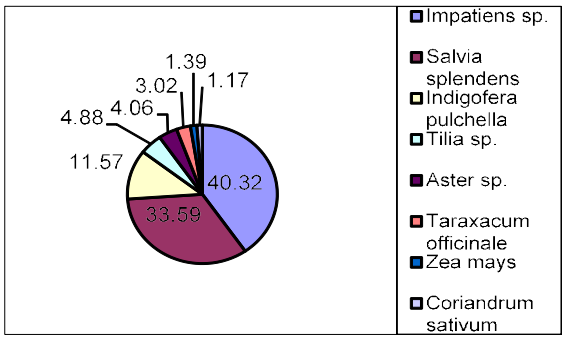

Fig 4: Bajaura-Multifloral.

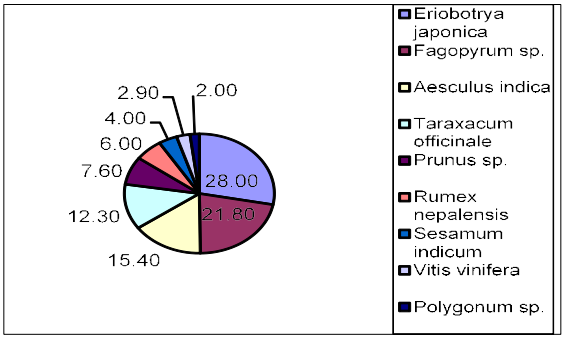

Fig 5: Sarabai-Multifloral.

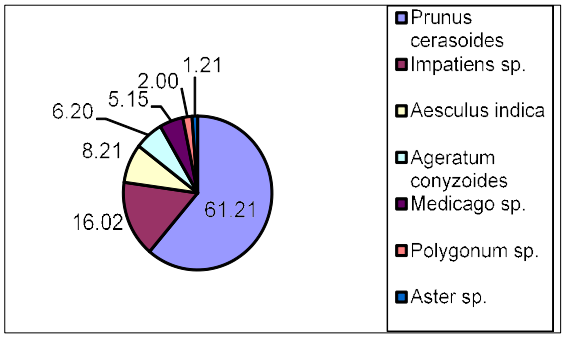

Fig 6: Bhunter-Unifloral.

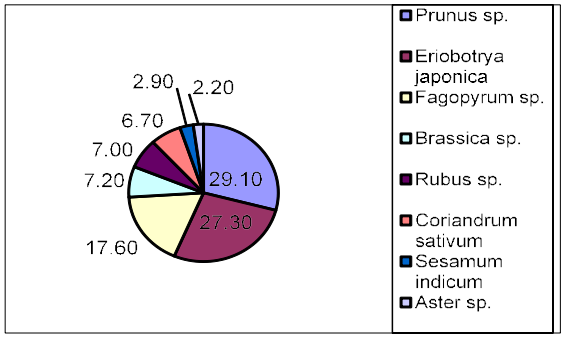

Fig 7: Shogi-Multifloral.

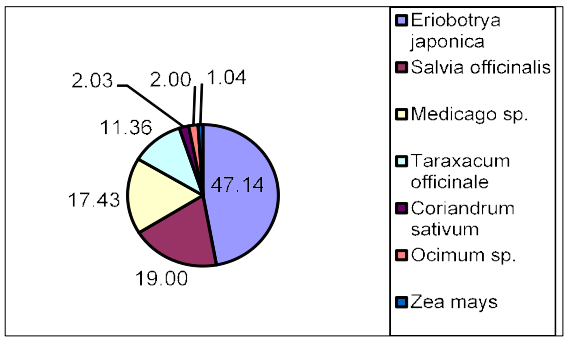

Fig 8: Garsa-Unifloral.

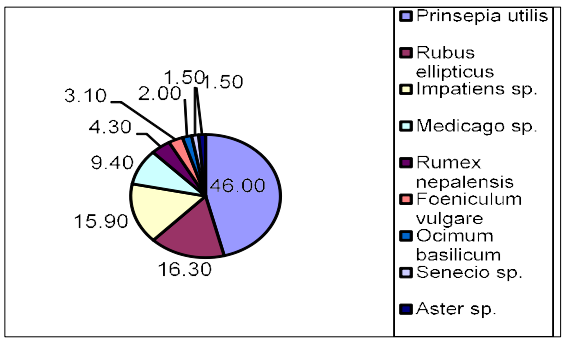

Fig 9: Mohal-Unifloral.

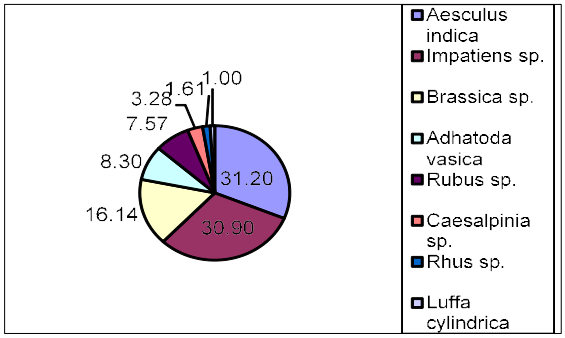

Fig 10: Sarvari-Multifloral.

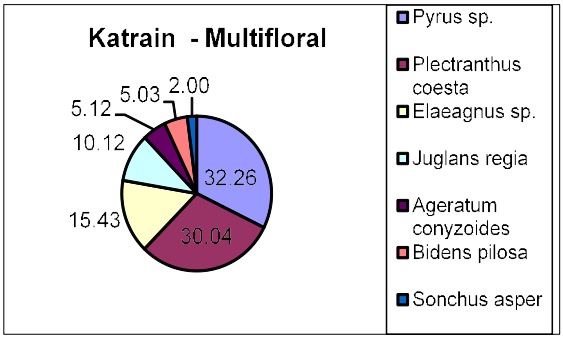

Fig 11: Katrain-Multifloral.

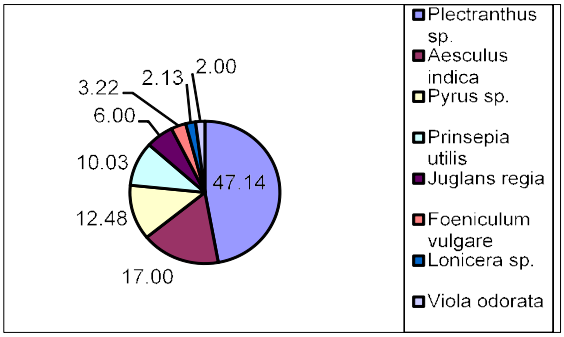

Fig 13: Patlikuhl-Unifloral.

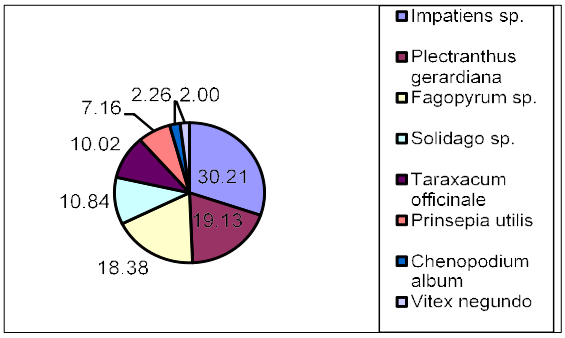

Fig 12: Banjar-Multifloral.

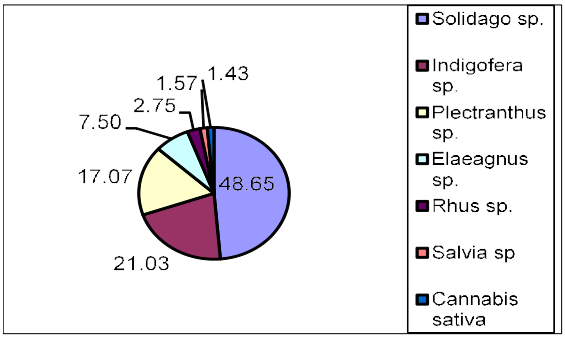

Fig 14: Bhekli-Unifloral.

The most widely represented families were Lamiaceae (*Salvia* sp.*, Salvia splendens, Salvia officinalis, Plectranthus coesta , Plectranthus gerardiana*, *Plectranthus* sp., *Ocimum basilicum, Ocimum* sp.); Asteraceae (*Ageratum conyzoides*, *Aster* sp., *Bidens* pilosa, *Solidago* sp., *Sonchus asper, Taraxacum officinale*, *Senecio* sp.); Rosaceae (*Eriobotrya japonica*, *Prinsepia utilis, Prunus cerasoides, Prunus* sp., *Pyrus* sp., *Rubus* sp., *Rubus ellipticus*); Fabaceae (*Caesalpinia* sp., *Cassia* sp., *Indigofera pulchella*, *Medicago* sp.); Polygonaceae (*Polygonum* sp., *Fagopyrum* sp., *Rumex nepalensis*); Apiaceae (*Coriandrum sativum, Foeniculum vulgare*), whereas, Acanthaceae, Amaranthaceae, Anacardiaceae, Arecaceae, Balsaminaceae, Brassicaceae, Cannabinaceae, Caprifoliaceae, Cucurbitaceae, Elaeagnaceae, Juglandaceae, Myrtaceae, Pedaliaceae, Poaceae, Sapindaceae, Tiliaceae, Verbenaceae, Violaceae and Vitaceae are represented by one member each.

Microscopic analysis showed that out of 50 morphological pollen types, 44 from were nectariferous and 6 from nectarless species as *Cannabis sativa, Juglans regia, Rumex nepalensis, Polygonum* sp. and *Zea mays*.

Melissopalynological analysis of autumn honeys indicates that Kullu hills have tremendous potential for the development of bee colonies and for sustainable beekeeping because of the diversity of nectar and pollen sources. The presence vast array of predominant, secondary, important and important minor pollen types in honey samples indicates that all samples were of botanical and geographical origin. The honey samples, rich in both pollen concentration and pollen diversity display a vivid landscape of the bee forage plants growing vicinity of beehive. This was also a clear indication of the wide range of collection of pollen grains from many flowering plants (Ebenezer and Olugbenga, 2010).

Fifty pollen types belonging to twenty five families were recorded in this study. Thirty three were identified to species level and 17 upto family level. The identified species belong to varying genera of native trees, herbs, shrubs and trees. There were pollen of varying shapes, sizes and morphological features. The pollen spectra of these honeys showed that honeybee's foraged considerable distance in search nectar and pollen which is needed for their survival and production of honey. The presence of these large number of pollen types also indicated that the honey samples were pure and not adulterated.

Pollen analytical data of the samples was given in Table 2 and 3. The predominant pollen types were *Prunus cerasoides, Eriobotrya japonica*, *Prinsepia utilis, Plectranthus* sp. and *Solidago* sp. The dominant wild trees/ plants were *Adhatoda vasica, Aesculus indica, Aster* sp., *Ageratum conyzoides, Bidens pilosa, Cannabis sativa, Cassia* sp., *Caesalpinia* sp.*, Elaeagnus* sp.*, Fagopyrum* sp., *Impatiens* sp., *Indigofera pulchella*, *Lonicera* sp., *Phoenix sylvestris, Plectranthus coesta, Plectranthus gerardiana, Polygonum* sp., *Prinsepia utilis, Prunus cerasoides, Rhus* sp., *Rubus ellipticus, Rumex nepalensis, Salvia officinalis, Senecio* sp., *Solidago* sp.*, Sonchus asper, Taraxacum* officinale, *Tilia* sp., *Viola odorata* and *Vitex negundo.* Cultivated plants were represented by *Brassica* sp., *Coriandrum sativum, Chenopodium* sp., *Eriobotrya japonica, Juglans regia, Foeniculum vulgare*, *Luffa cylindrica, Medicago* sp., *Ocimum basilicum, Pyrus* sp.,

Prunus sp., *Sesamum indicum,Vitis vinifera* and *Zea mays*. Ornamental plants include *Callistemon citrinus* and *Salvia splendens*.

CONCLUSION

From the above observations it is clear that the study area exhibits diversified flora and unlimited potential for bee forage. Moreover, the diverse pollen spectrum indicated that the honey samples are of botanical origin and are adulterated. This study also gives insights into the vegetation type of the respective locations in which honeys were produced as well as provides additional information on the major botanical florals foraged by honeybees in the studied region. Thus, identification of melliferous pollen taxons also helps in establishment of organized apicultural industry and for scientific development. It also helps beekeepers to formulate seasonal bee management programmes especially for migratory beekeeping.

Present melissopalynological studies revealed that honeys from Kullu fall under the category of Group I (<20,000 pollen grains), Group II (20,000-100,000) and to Group III (100,000-500,000) formed by International Commission for Plant Bee Relationships. *i.e.* honeys having absolute pollen count from 10,000 to 5,00,000 per 10 gm of honey.

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