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A Study of the Floristic and Nutritional Compositions of Bee Pollen from South Eastern Nigeria

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Abstract: ***The floristic and nutritional properties of bee pollen from Apis mellifera adansonii and Melipona species were examined using appropriate methods in the laboratory. The pollen pellets obtained randomly from the samples were weighed and recorded accordingly. Each of the pollen pellets contained approximately 6 and 10 plant pollen types with average weights of 0.10g and 0.21g for Apis mellifera adansonii and Melipona species respectively. The plant species identified in their pollen samples varied. This must have been as a result of differences in species preferences. The results of the proximate analysis revealed that Melipona species pollen had higher protein content (20.62%) than Apis mellifera pollen (19.29%). The value obtained from Apis mellifera pollen is lower than the amount required for optimum brood rearing (25% protein) and therefore might be a contributing factor to seasonal absconding of bees during the rains in southeastern Nigeria. However, bee pollen also contains other essential nutrients. The plant species contained in each of the pollen pellets should be inter planted in apiaries. Plants with high protein content that flower during the rains should also be studied. Bee pollen can serve as a protein supplement.***

Keyword: Bee pollen**,** *Melipona* species and *Apis mellifera*

1. Introduction

Bees belong to the third largest insect order (Hymenoptera) which also includes wasps and ants. Deforestation resulting from our traditional farming practices, urbanization and modernization continued to reduce the natural habitats and food of the honey bees at a rate which gives little chance for re-establishment of the vegetation. This has led to reduction in honey bee population and colonies.

Apis mellifera adansonii provides various useful products. These include: honey, pollen, propolis, royal jelly, bees wax and bee venom. Honey is referred to as one of the most valuable products of the forest produced by honey bees. It can be used as food and also one of the ingredients in various other industries such as pharmaceutical and cosmetic industries [1]. Besides the importance of *Melipona* species as major pollinators of most wild plants and some cultivated species, honey and bee pollen of meliponins are also source of food and medicines and income to rural populations [2, 3]. Therefore the rearing of the species becomes important. Unlike honey and propolis, the scientific study and uses of bee pollen is not yet widely studied in developing countries [4]. Pollen grains are small male reproductive units formed in the anthers of the higher flowering plants [4]. Pollen is a natural source of protein, fat, minerals and vitamins, which are necessary elements for the natural development of a bee colony and likewise in human nutrition [5]. The research work aimed at analyzing the floristic and nutritional compositions of two types of bee pollen (*Apis mellifera adansonii* pollen and *Melipona* species pollen).

2. Materials and Methods

2.1 Sample Collection

Pollen samples harvested from colonies of *Apis mellifera adansonii* and *Melipona* species located within south eastern Nigeria were used.

2.2 Determination of the Floristic Composition

2.2.1 Determination Number of plants contained per pollen pellet

Ten (10) pollen pollets were randomly selected from each of the samples. The weight of each pollen pellet was taken using a sensitive weighing balance and recorded accordingly as shown in Table 1. Each pollen pellet was dissolved in a beaker with 35ml of warm (40-50^{0}C) diluted sulphuric acid solution [6]. After a thorough shaking of the solution, it was centrifuged, decanted and the residue was acetolysed as described by [7, 8] and then suspended in 3ml glycerin alcohol in plastic vials for microscopic examination. Three drops of the thoroughly mixed suspension was mounted on the slide and examined under the microscope for pollen identification. The identification of pollen under the microscope was carried out with the aid of reference slides of plant pollen prepared directly from plants as well as photomicrographs of Nigerian plant pollen in books and journals by [8, 9, 10, 11]. The number of plant species found in each of the pollen pellets per sample was recorded in Tables 2 and 3.

2.2.2 Determination of the floristic compositions of *Apis mellifera* pollen and *Melipona* species pollen

1.0g of pollen was taken from each of the well blended pollen samples and prepared as described above and examined under the microscope at magnification 10 x 40 for pollen identification and counts (Table 4).

2.3 Determination of the Proximate Composition of Bee Pollen from South Eastern Nigeria

The proximate analysis was carried out as described by [12, 13, 14].

2.4 Statistical Analysis

T-test was used to compare the means of the two pollen samples (*Apis mellifera adansonii* pollen and *Melipona* species pollen). Significance was tested at 0.05 probability level. Also tables, bar chats were used to analyze the data.

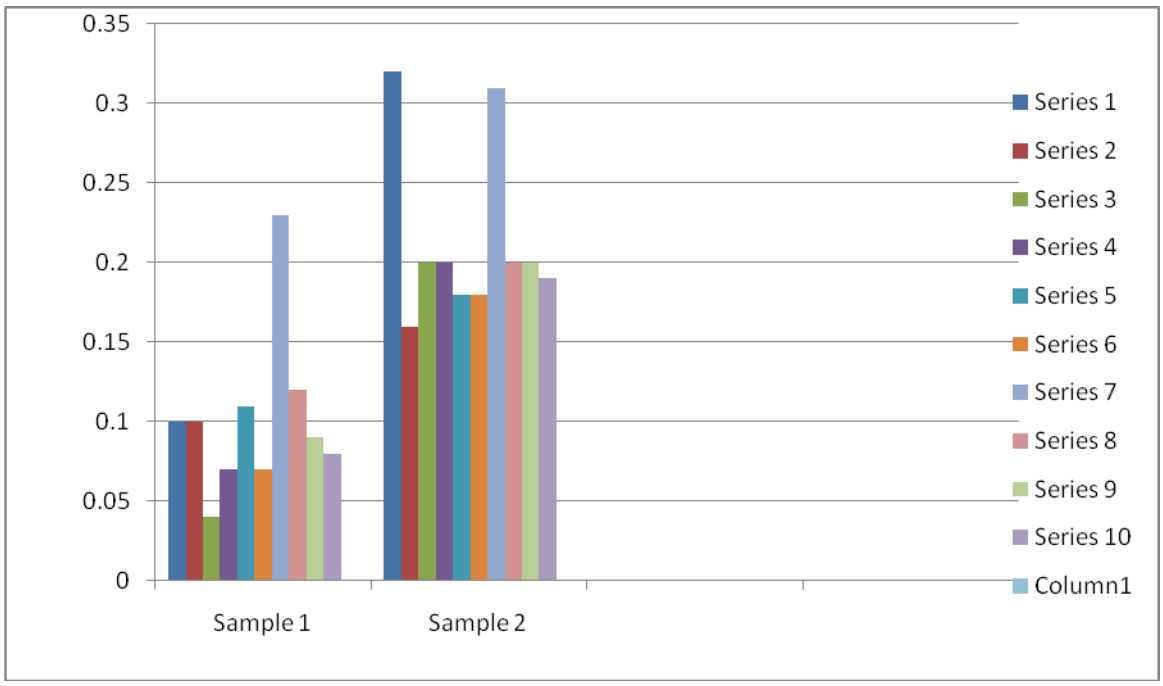
3. Results and Discussion

3.1Floristic Composition of Bee Pollen Samples from South Eastern Nigeria

Table 1: Weights of pollen pellets from the bee pollen samples collected from southeastern Nigeria.

Samples

Pollen pellets numbers	*Apis Mellifera Adansonii* pollen (g)	*Melipona* sp pollen (g)
1	0.10	0.32
2	0.10	0.16
3	0.04	0.20
4	0.07	0.20
5	0.11	0.18
6	0.07	0.18
7	0.23	0.31
8	0.12	0.20
9	0.09	0.20
10	0.08	0.19
Mean	0.10	0.21



Pollen pellets from different cells of honey combs.

Where, Sample 1 = *Apis mellifera adansonii* pollen (g)

Sample 2 = *Melipona sp* pollen (g)

Figure (1): Weights of pollen pellets from the Bee pollen samples collected from South Eastern Nigeria

Apis mellifera pollen had an average weight of 0.1g and *Melipona* species 0.21g. The variation in weights of the samples must have been as a result of the plant pollen types contained by the samples.

Table 2: Floristic compositions and frequencies of occurrence of pollen pellets extracted from sampled combs of *Apis mellifera adansonii* hives located within Southeastern Nigeria.

Pollen pellets number	*No. of plants pollen type Per pellet*	*Floristic Compositions*	*Frequency of occurrence*
1	7	*Lannea sp*	9
		Dioscorea exculenta	1300
		Elaeis guinensis	6
		Mimosa pudica	235
		Citrus sp	525
		Pterocarpus sp	75
		Compositae	18
2	5	*Elaeis guinensis*	1046
		Citrus sp	315
		Dioscorea exculenta	693
		Mimosa pudica	2400
		Rauvolfia vomitoria	33
3	4	*Dioscorea exculenta*	1820
		Citrus sp	128
		Pterocarpus sp	3
		Lannea sp	2
4	5	*Dioscorea sp*	2150
		Citrus sp	1800
		Jatropha sp	583
		Elaeis guinensis	562
		Barteria nigritiana	7
5	5	*Compositae*	1
		Elaeis guinensis	28
		Citrus sp	400
		Mimosa pudica	2225
		Lannea sp	556
6	4	*Irvingia gabonensis*	18
		Pterocarpus sp	5
		Lannea sp	21
		Elaeis guinensis	31
7	5	*Mimosa pudica*	1561
		Ipomea batata	437
		Compositae	1
		Irvingia gabonensis	9
		Corchorus olitorus	108
8	6	*Barteria nigritiana*	23
		Pterocarpus sp	1415
		Nauclea latifolia	14
		Steculia sp	28
		Citrus sp	143
		Dioscorea exculenta	863
9	7	*Citrus sp*	2
		Mimosa pudica	1681
		Elaeis guinensis	4
		Ipomea batata	3
		Lannea sp	1115
		Barteria nigitiana	1
		Khaya sp	324
10	8	*Hibiscus exculenta*	386
		Barteria nigritiana	9
		Pterocarpus sp	1826
		Dioscorea sp	2728
		Elaeis guinensis	325
		Lannea sp	22
		Citrus sp	553
		Nauclea latifolia	14
Mean	5.6		

Average plant pollen type per pellet = 5.6 plants per pollen pellet.

The results obtained as shown in Table 2 depicts that *Apis mellifera adansonii* stores approximately 6 plants per pellet. This must have been as a result of the wide variety of plants found in southeastern Nigeria. The plant pollens identified were as shown on the table above. The plant pollen types common in all the pollen pellets included *Dioscorea exculenta*, *Mimosa pudica*, *Citrus sp* and *Elaeis guinensis*.The frequencies of occurrence of these plants varied in each of the pellets. This must have been as a result of the flowering periods and preference by the bees. *Dioscorea exculenta* had the highest frequency (1300 pollens) in pollen pellet 1, *Mimosa pudica* (2400 pollens) was the highest in pollen pellet 2. The plant pollens with the highest frequencies in pollen pellets 3, 4, 8, 10, and 5, 6, 7, 9, were *Dioscorea exculenta* with frequencies of 1820, 2150, 863, 2728 and *Mimosa pudica* with frequencies of 2225, 1786 and 1681 respectively.

Table 3: Floristic compositions and frequencies of occurrence of sampled pollen pellets extracted from *Melipona Species* colony located within the Southeastern Nigeria.

Pollen Pellet Nos.	No. of Plant pollen type per pellet	Floristic compositions	Frequency of occurrence
1	10	*Andropogon sp*	118
		Hibiscus exculenta	60
		Tapinanthus sp	12
		Citrus sp	222
		Nauclea latifolia	5387
		Lannea sp	6
		Irvingia gabonensis	24
		Blighia sapida	306
		Asteraceae	6
		Ptercarpus sp	30
2	16	*Rauvolfia vomitoria*	13
		Fumtia elastica	1
		Bombax sp	272
		Pentaclethra macrophylla	420
		Lea guinensis	121
		Lannea sp	9
		Nauclea latifolia	318
		Irvingia gabonensis	3
		Compositae	11
		Tapinanthus sp	68
3	10	*Citrus sp*	3
		Combretum sp	1
		Newbouldia laevis	639
		Pterocarpus sp	*13*
		Hildegardia barteri	63
		Dialium guinensis	5
4	9	*Tapinanthus sp*	1347
		Compositae	1
		Newbouldia laevis	3
		Cardiospermum sp	1746
		Allophylus sp	7
		Pterocarpus sp	731
		Occimium gratisimum	345
		Blighia sapida	78
		Lannea sp	11
		Citrus sp	2
		Pentaclethra macrophylla	24
		Andropogon	189
		Compositae	1
		Irvingia gabonensis	7
		Citrus sp	13
		Spondias mombin	1
		Blighia sapida	5
		Khaya sp	11
		Nauclea latifolia	945
5	8	*Ipomea batata*	1557
		Khaya sp	19
		Citrus sp	722
		Trichilia sp	12
		Combretum sp	1
		Bombax bounopouzense	18
		Spondias mombin	927
		Hymenocardia acida	102
6	7	*Nauclea latifolia*	3315
		Andropogon sp	17
		Lannea sp	25
		Jatropha sp	4
		Steculia sp	5
		Khaya sp	2
		Trichilia sp	1
7	7	*Nauclea latifolia*	6624
		Hibiscus exculenta	1
		Lannea sp	14
		Pterocarpus sp	10
		Barteria nigritiana	1
		Allophyllus sp	*6*
		Bombax bounopozense	5
8	9	*Andropogon sp*	604
		Pentaclethra macrophylla	47
		Irvingia gabonsis	48
9	9	Ceiba *pentandra*	12
		Hildegardia barteria	2957
		Triplochiton sclerezylon	1852
		Hibiscus sp	25
		Blighia sapida	1
		Compositae	1
10	11	*Citrus sp*	30
		Terminalia sp	8
		Crossopteryx febrifuga	19
		Terminalia sp	8
		Steculia sp	3
		Andropogon sp	513
		Hildegardia barteri	225
		Uapaca sp	233
		Rauvolfia vomitoria	18
Total	9.6	*Triplochiton sclerexylon*	5038
		Blighia sapida	39
		Hildegardia barteri	27
		Hibiscus exculenta	14
		Lannea sp	9
		Jatropha sp	9
		Pterocarpus sp	4
		Pentaclethra macrophylla	11
		Fumtia elastic	2
		Lannea sp	18
		Uapaca species	5176

Average floristic composition for pollen pellet = 9.6 pollen types per pellet

Each of the pollen pellets for *Melipona* species varied in their floristic composition with few of the pollen types found in more than one pellet sampled. The results presented in Table. 3 above showed that *Melipona* species pollen stored approximately 10 pollen types per stored pollen pellet. Some of the species identified and their frequencies of occurrence were *Nauclea latifolia* (5387),*Newbouldia laevis* (639), *Cardiospermum sp* (1746) *Uapaca sp* (5176), *Nauclea latifolia*(945), *Ipomea batata* (1557), *Nauclea latifolia* (6624) *Hildegardia barteri* (2951), *Andropogon sp* (604), *Uapaca sp* (5176) and were the predominant plant species found in pollen pellets 1 to10 respectively. These predominant plant species must have been collected by the bees as a result of their preferences to the bees as well as their availability due to their flowering periods. The *Melipona sp* pollen grain showed a higher average number of pollen types (10) per pollen pellet than *Apis mellifera adansonii* pollen (6) per pollen pellet. This might have resulted as a result of differences in species preferences for pollen. Therefore the analysis indicates that the *Melipona sp* collects more plant pollen types than the *Apis mellifera adansonii*. Some of the pollen types collected by the *Melipona species* were also found in the *Apis mellifera* pollen. These plant pollens were *Citrus sp, Nauclea latifolia, Compositae*, *Lannea sp* and *Ipomea batata*.The combination of these plant species in each of the pellets by the bees may not be a coincidence but can be as a result of the chemical compositions of each of these plants which are necessary to the bees.

Table 4: Floristic Compositions of the Bee Pollen Samples from Southern Nigeria

Floristic composition	*Apis Mellifera* pollen Frequency	*Melipona* species pollen Frequency
AMPELIDAE		
Leea guinensis	12	-
ANARCARDIACEA		
Lannea sp	591	72
Spondias mombin	821	1
APOCYNACEAE		
Astonia boonei	-	-
Rauvolfia vomitoria	-	31
Fumtia elastica	-	1
BIGNONACEAE		
Newboldia laevis	-	642
BOMBACACEAE		
Bombax bounopozense	-	295
Ceiba pentandra	-	13
CAESALPINACEAE		
Dialium guinensis	-	5
COMBRETACEAE		
Combretum sp	-	2
COMPOSITAE	231	2
CONVOLVULACEAE		
Ipomea batata	440	1557
DIOSCOREACEAE		
Dioscorea exculenta	5978	-
EUPHORBIACEAE		
Jatropha sp	583	13
Uapaca sp	-	5411
Hymenocardia acida	-	102
Irvingia gabonensis	27	-
LORANTHACEAE		
Tapinanthus sp	-	1427
MALVACEAE		
Hibiscus sp	386	100
MELIACEAE		
Khaya sp	11	32
Trichilia sp	-	13
MIMOSACEAE		
Mimosa pudica	6663	-
Pentaclethra macropylla	-	502
PALMAE		
Elaeis guinensis	1479	-
Raphia sp	-	-
PAPILONACEAE		
Pterocarpus sp	1909	775
PASSIFLORACEAE		
Barteria nigritiana	34	-
RUBIACEAE		
Nauclea latifolia	1143	311
RUTACEAE		
Citrus sp	4352	1077
SAPINDACEAE		
Blighia sapida	-	429
Allophyllus sp	-	13
Cardiospermum sp	-	1746
Barteria nigritiana	34	-
RUBIACEAE		
Nauclea latifolia	1143	311
RUTACEAE		
Citrus sp	4352	1077
SAPINDACEAE		
Blighia sapida	-	429
Allophyllus sp	-	13
Cardiospermum sp	-	1746
STECULIACEAE		
Steculia sp	21	1746
Tryplochiton sclerexylon	-	2890
Hildegardia barteri	-	3266
TILIACEAE		
Corcorus olitorus	108	3266
Grand Total:	24,796	20,736
No. of pollen Types	18	28

A total number of eighteen (18) pollen types were identified in *Apis mellifera* pollen sample and twenty eight (28) pollen types were found in *Melipona species* pollen (Table 4).The plant species collected by the bees for pollen collection included *Citrus sp*, *Nauclea latifolia*, *Mimosa pudica*, *Pterocarpus sp*, *Dioscorea sp*, *Uapaca sp*, *Ipomea batata*, *Elaeis guinensis*. These plants had the highest frequencies as indicated in table 4 and have also been identified by Agwu and Agbaeze (1998), Akachuku (2002) as honeybees' plant species.

Table 5: T-test of the Proximate Compositions of Bee Pollens of *Apis-mellifera adansonii* and *Melipona Species*

Sample	Moisture	Crude fibre	Ash	Fat	Protein	Carbohydrate
Apis mellifera	20.05	2.51	12.80	1.96	19.10	43.54
Melipona sp	39.19	3.02	12.06	2.86	20.61	22.24
T-cal	-35.057	-23.49	4.61	-58.92	-5.97	32.70
Sig (2-tailed)	.000	.000	.010	.000	.004	.000

❖ Values are the means of three replicates

The comparative analysis of the two pollens showed highly significant differences as shown in Table 5. The *Melipona species* was higher in Moisture (39.19%), Fiber (3.02%), Fat (2.86), and Protein (20.61) than 20.05%, 2.15%, 1.96%, and 19.10% respectively found in the *Apis* mellifera *adansonii* pollen. A higher percentage ash (12.80%) and carbohydrate (43.54%) were found in *Apis mellifera* pollen while 12.07% (ash) and 22.24% carbohydrate respectively was contained by the *Melipona sp* pollen. The lower moisture content found in *Apis mellifera* pollen indicated that it has a longer shelf life than the *Melipona* species pollen. Water content of a product determines its shelf life [15, 16, 17]. The crude protein levels were 19.22% and 20.60% for *Apis mellifera adansonii* and *Melipona* species respectively. The results obtained are within the range (7.5 to 35%) reported by [4] as the typical range of protein content of bee pollen. The bee pollen is rich in protein and thus can be taken as protein supplement. The nutritional benefits of protein from various floral sources can be divided into three general categories. Pollens with >25% crude protein were classified as excellent quality, 20-25% crude protein as average quality and <20% crude protein as poor quality [18]. The results were lower than 25% considered as excellent quality of pollen required for optimum brood rearing and colony performance. This must have been as a result of the floral sources of the pollen samples which may not be excellent sources of protein. Relating the most frequent plant species in *Apis mellifera* pollen to their flowering periods, this sample must have been produced during the rainy season, and therefore since the protein content of that sample was not up to the 25% needed for optimum brood rearing might be a contributing factor to the reduction of brood rearing during the rains and also seasonal absconding of bees in southeastern Nigeria. Ample protein promotes a high birth rate and long –lived bees whereas low protein intake minimizes the number of brood reared and the longevity of adult bees [18, 19]. The results obtained from the analysis 19.22%and 20.62% protein were close to the percentage contained by some other good sources of protein such as fish (19%), meat (18%) soybean (34%) common dry bean (22%) as reported by [20].Therefore pollen can serve as a good source of protein.

4. Conclusion \ Recommendations

The study showed that the good floral sources of bee pollen required by the bee species in southeastern Nigeria included: *Mimosa* pudica, *Citrus species*, *Pterocarpus sp*, *Dioscorea sp*, *Ipomea batata*, *Nauclea latifolia* and *Uapaca sp*.

The *Melipona species* collected a wider variety of plants than the *Apis mellifera adansonii*. However, *Apis mellifera adansonii* frequencies of visits to the different plants are higher. *Apis mellifera* stores approximately six (6) plants per pellet while the *Melipona species* stores approximately eleven (10) plant species per pellet. It has also been found from this analysis that bee pollen contains all the essential nutrients .The percentage protein contained in the sample are lower than the adequate amount needed for optimum brood rearing and colony production and might be a contributing factor to seasonal absconding of bees during the rain. However, the following recommendations are made: the identified floral sources of bee pollen should serve as a guide to beekeepers in establishing farms (apiaries) .The plant species found in each of the pollen pellets should be inter-planted in apiaries as the availability of these plant species will enhance pollen quality and quantity. Also, the identified plants should be conserved. Research, should be carried out on individual plant pollen to determine the nutrient composition of each plant species especially for these plants that are frequently visited by the bees to determine their contributions to colony growth.

References

[1] Akachuku CO Conserving the natural forest biodiversity in Niger delta through sustainable keeping. NAAS proceeding 2001; pp 229-309.
[2] Freitas BM A vida das Abelhas craveiro and craveiro, Fortaleza, CE,Brasil CD.Rom 1999.
[3] Tania MS, Silva Celso A, Camera Antomo CS, Lins Mariade Fatima Agra,Eva MS, Silva Igor T, Reis Breno M, Freitas Chemical composition, botanical evaluation and screening of radical scavenging activity``of collected pollen by rhestingless bees *Melipona rugiventris* (Urucu-amarela). Anais de Academia Brasileira de Ciencias, 2009; pp 2.
[4] FAO Value-added products from beekeeping .FAO of United Nations Agricultural services bulletins, Rome, 1996; pp124.
[5] Cobo A EL pollen: problematicaY perspectivas El campo.1984, Pp 69-77.
[6] Lieux MH Acetolysis applied to microscopical honey analysis. Grana 1980, 19:57-61.
[7] Erdtman G The acetolysis method; a revised description.1969; p564- 565.
[8] Agwu COC and Agbaeze CC Palynological study of honey from Anambra and southern Benue state of Nigeria. *Journal of science and technology* 1992; (2)357-362.
[9] Sowunmi MA Pollen grains of Nigerian plants I (woody species) Grana 1973; 13:145-186.
[10] Sowunmi MA The potential value of honey in palaeopalynology and Archaelogy. Review of palaeobotany and palynology 1976; 21; 171-185

[11] Sowunmi MA Pollen of Nigeria plants II (woody species), Ibadan Nigeria 1995; p 1-4.
[12] AOAC Official methods of analysis. Association of official chemists, Washington, DC, USA, 1995; pp2-15.
[13] James CS Experimental method of analytical chemistry of foods. Chapman and hall, New York 1995.
[14] Pearson D the chemical analysis of food 7th ed. Church hill store, London 1976; pp. 572.
[15] Serra Bonvehi .J; Gomez Pajuelo .A; Gonell Galindo F Larecolte du pollen Rev.fr. Apic. (1987a), 464,300-301.
[16] Serra Bonvehi J;Gomez Pajuelo A; Gonell Galindo F Sechage at conservation du pollen Rev frome. 1987b; Apic.465, 54- 355.
[17] Jodral M; Fernaridez .C; Bentabol A; Linain. E Elpolen apicola comosustrato parala produccion deaflatoxinasi (Aglatoxin formation in bee pollen.) Alimentaria, 1992; 236, 67-68.
[18] Kleinschmidt G and Kondos A The influence of crude protein levels on colony performance. *Australasian beekeeper* 1976; 79,251-257.
[19] Schmidt JO, Schmidt PJ Pollen digestibility and its potential nutritional value. Bee cult, 1978; 112, 320-322.
[20] Shubhangini .A. Joshi Nutrition and Dietetics, Second Edition, Tata Mc Grew-Hill publishing company limited, New Delhi 2000.