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Identification of Bee Plants and Analysis of Honey Collected from Different Plant Sources

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Abstract: Bee plants grown in and around Bangladesh Agricultural University campus were identified on the basis of the frequency of visits by the worker bees to the flowers of these plants. All together 29 bee plants were identified in "honey flow season" (December to March). Nine of these plants did not provide pollen and five of them did not provide nectar. Bee plants were 34 in number in "dearth period" (April to July). Of these, 15 plants did not provide pollen and 12 did not supply nectar. Only four bee plants were identified in "extended period" (August to November). Most of them provide only pollen. There were five bee plants, which provide pollen and nectar throughout the year. It was found that on an average drumstick honey contained the highest moisture (26.48%) followed by mustard (25.72%) and black berry (21.94%). The lowest moisture (18.50%) was found in litchi honey. Highest and lowest reducing sugars were obtained in mustard honey and blackberry honey. On the otherhand, litchi honey contained highest (5.50%) non-reducing sugar and mustard honey contained the lowest (4.69%). Total sugar was the highest (72.70%) in mustard honey followed by litchi (70.20%). Ash content was highest (0.54%) in Drumstick honey followed by blackberry and litchi honey.

Key words: Bee plant, nectar, reducing sugar, honey, pollen

Introduction

Honey bee gather nectar and pollen from bee plant as their food and the pollen foraging activities of honey bees are varied time to time (Hossein, 1992). Pollen gathering activity is dependent upon the availability of pollen yielding flowers and the environmental conditions like sunrise, sunset and day temperature etc. It is therefore, the interaction of flora and these interactions presumably determine the pattern of pollen gathering activity. As nectar and pollen are raw materials of the bee keeping industry, a through knowledge of the honey and pollen plants of a locality and the conditions that govern the production of two substances are of paramount importance. Maximum area of stored pollen was recorded in February and minimum in October in *Apis cerana* colonies and in *Apis mellifera* colonies the maximum and minimum quantities were recorded in March and October respectively (Rahman and Rahman, 1993). Pollen collections were higher when honey collections were more (Baker, 1971).

Honey is a sweet viscid fluid collected from the nectaries of flowers elaborated for food by several kinds of insects especially, by the honeybees. More specifically honey is the nectar obtained from flowers by worker bees, which after modification in the stomach of the bees is stored in the cells of the comb for nourishment of the young brood. Capped honey contains nearly 19% water and 80% sugar in the form of dextrose and levulose (Alamanni, 1994). Honey is the only medium where no bacteria by any means can germinate due to the presence of sugar content and because of its acidic reaction. On the other hand, it was proved that no diseases of honeybees could be transferred to other animals through honey. Honey has unique position among energy food. It is used with bread and beverage. It has long been recognized as an antiseptic and also used in many kinds of cosmetics. In view of manifold importance of bee plants and honey the study had been under taken to find the availability of various bee plants and the composition of honey collected from different bee plants.

Materials and Methods

The experiment on identification of bee plants and analysis of honey collected from different plant sources were carried out in Bangladesh Agricultural University, Mymensingh from April 1998 to March 1999. Statistical analysis were done by Duncan's multiple range test of Gomez and Gomez (1984).

Identification of various bee plants: Bee plants grown in and around Bangladesh Agricultural University campus were observed to determine the visits made by the worker bees to the flowers of these plants. These observations were continued throughout the year. The bee plants were identified and graded on the basis of the frequency of visits of the bees to the flowers for collection of nectar and pollen. Identified bee plants were grouped as those available in honey flow season (December to March), in dearth period (April to July), in extended period (August to November) and in period during all the year round.

Analysis of honey: Four different types of honey were taken for study i.e., mustard (*Brassica campestris*), drumstick (*Moringa oliefera*), black berry (*Syzigium cumini*) and litchi (*Litchi chinensis*) honey. The names of the honey followed the corresponding plant sources from which the nectar was collected by the worker bees. During analysis of honey the following physical and chemical parameters were taken into consideration: I) moisture content, ii) ash content, iii) reducing sugar content, IV) total sugar and V) non-reducing sugar content.

The above parameters were determined using the methods of Ranganna (1991).

Moisture: Five grams of the honey was taken in porcelain crucibles in tetrad and oven-dried at 100°C until the weight became constant. Percent moisture content was calculated according to the following formula:

$$\text{Moisture \%} = \frac{I-F}{I} \times 100$$

Where, I = Initial weight of honey and F = Final weight of honey

Ash: The oven-dried sample from (I) above was transformed into ash in a muffle furnace at 600°C for 6 h after initial preashing at 200°C and percent ash was calculated as follows:

$$\text{Ash \%} = \frac{A}{I} \times 100$$

Where, A = Weight of ash and I = Initial weight of honey.

Reducing sugar: Twenty percent honey solution was prepared by dissolving honey in distilled water in a beaker. Fifteen ml of the solution and 10 ml of lead acetate solution were taken in a 250 ml volumetric flask. The volume was made 250 ml by adding distilled water. After thorough shaking the solution 100 ml of filtrate was taken into a 250 ml volumetric flask and 5 ml of potassium oxalate was added. Finally, the volume was made 250 ml by adding distilled water. The solution was filtered into a burette and then titrated against a measured amount of Fehling's solution. The Fehling's solution had earlier been titrated with standard dextrose solution. Percent reducing sugar was calculated as follows:

$$\text{Reducing sugar \%} = \frac{I \times D \times 100}{T \times D \times 1000}$$

Where, I = mg of dextrose required to reduce the known volume of Fehling's solution, D = Dilution, T = Titre and W = Weight of sample.

Total sugar: Fifty ml of the titrate obtained were taken in a 250 ml volumetric flask and 10 ml of conc. HCl were added to it. The mixture was allowed to stand at room temperature for 24 h, neutralized with NaOH solution, made the volume up to the mark with distilled water and then titrated against measured volume of Fehling's solution. Percent total sugar was calculated as in (iii) making use of titre volume obtained in determination of total sugar after inversion.

Non-reducing sugar: Non-reducing sugar content was calculated as follows:

Non-reducing sugar % = Total sugar % - Reducing sugar %

Results and Discussion

Identification of seasonal bee plants: All together 29 bee plants were identified in "honey flow season" (December to March). Nine of these plants did not provide pollen and five of them did not provide nectar (Table 1). Bee plants in "dearth period" (April to July) were 34 in number. Of these, 15 plants did not provide pollen and 12 did not supply nectar (Table 2). Only four bee plants

Table 1: Bee plants during "honey flow season" (December 1998 to March 1999)

Local/English name	Scientific name	Flowering duration	Pollen	Nectar
Mustard	*Brassica campestris*	Nov.-Jan.	Pollen^{++}	Nectar^{++}
Sajina	*Moringa olefera*	Oct.-Feb.	Pollen^{+}	Nectar^{++}
Shimul	*Bombax ceiba*	Feb.-Mar.	Pollen^{+}	Nectar^{++}
Blackberry	*Syzigium cuminiu*	Mar.-Apr.	-	Nectar^{++}
Golapjam	*S. jambos*	Mar.-Apr.	Pollen^{+}	Nectar
Chalkumra	*Benincasa hispida*	Feb.-May.	Pollen^{++}	-
Spinach	*Spinacea oleracea*	Feb.-Apr.	Pollen^{++}	Nectar^{+}
Caulilower	*Brassica oleracea*	Feb.-Apr.	Pollen	Nectar
Turnip/Shalgam	*B. rapa*	Dec.-Jan.	Pollen	Nectar
Gram	*Cicer arietinum*	March	-	Nectar
Lemon	*Citrus aurantifolia*	Feb.-Mar.	-	Nectar
Jambura	*Citrus grandis*	Feb.-Mar.	-	Nectar^{+}
Coriandar	Coriandrum sativum	Feb.-Mar.	Pollen^{++}	Nectar^{+}
Sweet gourd	*Cucurbita maxima*	Nov.-Dec.	Pollen^{++}	Nectar^{++}
Sunflower	*Halianthus annus*	Feb.-Mar.	Pollen	Nectar^{+}
Danda kalash	*Leucus aspera*	Nov.-Jan.	-	Nectar
Tobacco	*Nicotiana tabacum*	Jan.-Feb.	-	Nectar^{++}
Tulshi	*Ocimum sanchum*	March	-	Nectar
Khajur	*Phoenix sylvestris*	Jan.-Feb.	Pollen	Nectar^{+}
Raddis	*Raphanus sativus*	Feb.-Mar.	Pollen^{+}	Nectar
Brinjal	Solanum melongena	Nov.-Mar.	Pollen	Nectar
Onion	*Allium cepa*	March	Pollen^{+}	-
Data	*Amaranthus tricolor*	Oct.-Nov.	Pollen^{+}	-
Apple (Ata)	*Pyrus malus*	Nov.-Feb.	Pollen	-
Mango	*Mangifera indica*	Feb.-March	-	Nectar
Nonaata	*Anona reticulata*	Nov.-Feb.	Pollen	-
Palm tree	*Borassus flabellifer*	March	Pollen^{+}	Nectar^{+}
Litchi	*Litchi chinensis*	Mar.-Apr.	Pollen^{++}	Nectar
Wheat	*Triticum aestivum*	Jan.-Feb.	-	Nectar

Pollen = Insufficient quantity of pollen collected by bees
Pollen^{+} = Normal quantity of pollen collected by bees.
Pollen^{++} = Sufficient quantity of pollen collected by bees.
Nectar = Insufficient quantity, Nectar^{+} = Normal quantity
Nectar^{++} = Sufficient quantity

Table 2: Bee plants during "dearth period" (April to July 1998)

Local/English name	Scientific names	Flowering Duration	Pollen	Nectar
Lady's finger	*Abelmoschus esculentus*	March-January	Pollen^{++}	-
Bel	*Aegle marmelos*	May-June	-	Nectar
Betel nut	*Areca catechu*	March-June	Pollen^{++}	Nectar^{+}
Kam ranga	*Averrhoa carambola*	May-June	-	Nectar^{+}
Neem	*Azadirachta indica*	April-May	Pollen	Nectar^{+}
Hijal	*Barringtonia acutangula*	April-May	Pollen	Nectar
Badar kathi	*Cassia fistula*	May	Pollen	-
Nayan tara	*Catharanthus roseus*	June-August	-	Nectar^{++}
Pata bahar	*Codiacum variegatum*	June	Pollen	-
Bangi futi	*Cucumis melo*	February-April	-	Nectar^{+}
Cucumber	*Cucumis sativus*	June-July	-	Nectar^{+}
Gandharaj	*Gardenia jasminoides*	June-July	Pollen^{+}	-
Danta majan	*Glycosmis pentaphylla*	June-July	-	Nectar^{+}
Cotton	*Gossypium harbaceum*	April-May	-	Nectar^{+}
Jute (Mesta)	*Hibiscus canabinus*	April-July	-	Nectar^{+}
Bonkalmi	*Ipomoea pepiaria*	April-May	Pollen	-
Kalmilata	*Ipomoea aquatica*	April-May	Pollen	-
Pulse (khesari)	*Lathyrus sativus*	March-April	-	Nectar^{+}
Jhinga (Ribbed gourd)	*Luffa acutangula*	June-July	Pollen^{++}	-
Negesshar	*Mesua nagassarium*	May-June	-	Nectar
Lajjaboti	*Mimosa pudica*	April-July	Pollen^{++}	-
Bakul	*Mimusops elengi*	May-June	Pollen^{+}	Nectar^{+}
Kakrol	Momordica cochinchinensis	June-July	Pollen^{++}	-
Bon tulsi	*Ocimum basilicum*	June-July	-	Nectar
Amloki	*Phyllanthus emblica*	March-June	-	Nectar
Kamini	*Murraya exotica*	June-July	-	Nectar
Bish katali	*Polygonum hydropiper*	May-June	Pollen^{++}	-
Tamarind	*Tamarindus indica*	April-June	-	Nectar
Shegun	*Tectona grandis*	June-August	Pollen^{+}	Nectar
Chichinga	*Trichosanthes cucumarina*	June-July	Pollen^{+}	-
Khudi jam	*Syzygium fruticosum*	March-April	Pollen^{+}	Nectar
Rain tree	*Samanea saman*	June-July	Pollen^{+}	Nectar
Eucalyptus	*Eucalyptus globulus*	June-July	-	Nectar
Korolla	*Momordica charantia*	April-June	Pollen^{++}	-

Table 3: Bee plants during "extended period" (August to November, 1998)

Local/English name	Scientific names	Flowering duration	Pollen	Nectar
Kul barai	*Zizyphus mauritiana*	Sept.-Nov.	-	Nectar^{+}
Data	*Amaranthus sp.*	Oct.-Nov.	Pollen^{+}	-
Kata Babla	*Acacia nilotica*	Nov.-Dec.	Pollen^{+}	-
Shishu	*Dalbergia sisoo*	Aug-Sept.	Pollen^{+}	-

Table 4: Bee plants during "all the year round" (March 1998 to February, 1999)

Local/English name	Scientific names	Flowering duration	Pollen	Nectar
Banana	*Musa sapientum*	All the year round	Pollen^{+}	Nectar^{+}
Coconut	*Cocos nucifera*	-do-	Pollen^{+}	Nectar^{+}
Papaya	*Carica papaya*	-do-	Pollen^{++}	Nectar^{+}
Green banana	*Musa paradisiaca*	-do-	Pollen^{+}	Nectar^{+}
Bottle gourd	*Lagenaria siceraria*	-do-	Pollen^{+}	-

Nectar^{-} = Insufficient quantity, Nectar^{+} = Normal quantity, Nectar^{++} = Sufficient quantity, Pollen^{-} = Insufficient quantity of pollen collected by bees Pollen^{+} = Normal quantity of pollen collected by bees, Pollen^{++} = Sufficient quantity of pollen collected by bees

Table 5: Composition of honey collected from different honey sources.

	Percentage of				
Honey sources	Moisture**	Reducing sugar**	Non-reducing sugar*	Total sugar**	Ash**
Black berry	21.94c	64.11b	5.40a	69.49b	0.45b
Mustard	25.72b	68.01a	4.69b	72.70a	0.19c
Drum stick	26.48a	64.45b	5.20ab	69.70b	0.54a
Litchi	18.50d	64.90b	5.50a	70.20b	0.20c
Sx	0.104	0.199	0.161	0.198	0.005
CV (%)	0.89	0.61	619.0	0.56	5.55

Within column means followed by same letter (s) did not differ significantly at * P< 0.05, ** < 0.01 respectively by DMRT

were identified in "extended period" (August to November) (Table 3). Most of them provide only pollen. There were five bee plants, which provide pollen and nectar throughout the year (Table 4). Loper (1991) observed the influence of necter and pollen availability and blossom density on the attractiveness of almond cultivars to honey bees. The number of foraging honey bees per flower did not differ among cultivars in either year, but cultivars with the greatest number of flowers per meter also had the highest nectar and pollen collection per meter and attracted the greatest number of honey bees. According to Mutsaers (1991), the main nectar flow was from July to February with a peak in January when the forest trees were in flower. Malerbo (1992) observed bee forage plants and the development of honey bee colonies (*Apis mellifera*) in the agricultural region of Jaboticabal and Bazil in 1986-87. He found that the availability of bee forage was the best in June-September and poorest in November-April. The findings of this study did not correlate with those studies. This might be due to different locations and environments.

Analysis of honey: After analysis of honey it was found that on an average drumstick honey contain the highest moisture (26.48%) followed by mustard (25.72%) and black berry (21.94%). The lowest moisture (18.50%) was found in litchi honey. Highest reducing and non-reducing sugars obtained in mustard honey and litchi honey respectively and the lowest were blackbery honey and mustard honey respectively (Table 5). Kalpana (1996) studied two honey samples from an *Apis cerana* near some sugarcane fields and found that the honey samples contained just over 70% total reducing sugar over 2.5% sucrose and 21.0-21.5% water. Tilde (1991) studied wild honey types and Melifer honey types in the Philippines and reported that the average reducing sugar content for both honey types was below the value recommended by FAO/WHO Codex Alimentarious commission. The standards registered honey contains an average sugar of 66.48% which is in accordance with the recommended values. Total sugar was the highest (72.70%) in mustard honey followed by litchi (70.20%). Ash contents was the highest (0.54%) in Drumstick honey followed by blackberry honey and litchi honey. According to Tian (1994) mineral composition and ash contents of the honey of *Apis mellifera* were 0.122 and 0.22% respectively. The composition of honey of different plant sources was found statistically significant (Table 5). The comparative results indicated that the mustard honey contained more total sugar and was therefore, the most preferable honey. But litchi honey could be stored for a longer period because of the presence of less amount of moisture in it.

Successful bee keeping and honey production was entirely depend on the availability of bee plants. It is interesting to note that the relationship between honey bees and bee plants is on give and take basis. Many plants require the visits of honey bees for cross-pollination. Every minute the bees remove pollen from their bodies with their pollen brushes and collect surplus pollen in their buskets. Whereas, honeybee help to bring the male and female parts of flower together and thus arrange fertilization of the ovum. The blossoms give nectar and pollen for the bees to eat and make honey from nectar only and not from pollen. Thus the honeybee and bee plants are equally important to produce honey.

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