



POLLEN ANALYSIS OF HONEY FROM THE HIZAN DISTRICT OF BITLIS PROVINCE, EASTERN REGION OF TURKEY

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ABSTRACT: The present study reports the results of pollen analyses of Hizan district of Bitlis province, eastern region of Turkey. The pollen content of 20 honey samples were analysed and 9 botanical families were identified. The results showed that the pollen types of *Fabaceae*, *Asteraceae*, *Boraginaceae*, *Brassicaceae*, *Rosaceae*, *Apiaceae*, were the most abundant among the samples. The dominant group of pollen grains consisted of *Fabaceae* and *Asteraceae* families more than 20 % of samples. The pollen of *Chenopodiaceae*, *Asteraceae*, *Lamiaceae*, *Ericaceae* were present in less than 3 % of samples. The pollen analyses revealed 20 honey samples produced from multifloral honeys. The current information provides new insights into the pollen composition of Hizan district of Bitlis province honey and could be used to develop analytical standards for the pollen content of Hizan district of Bitlis province eastern region of Turkey.

Key words: Pollen, honey, melissopalynology, Hizan district of Bitlis.

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INTRODUCTION

The botanical origin of honey can characterise differences between colour, taste, flavour and content of physiologically active ingredients. There are several methods for determining the origin of honey. However, the information on sugar composition, electrical conductivity and amino acid analysis of honey is not always a reliable determination of the botanical origin of honey [1]. The most common method used to determine the botanical origin of honey is pollen analysis. There are four natural resources required by honey bees for survival: water, resin, nectar and pollen [2]. Nectar is a sweet liquid secreted by flowers of plants, consumed by bats, hummingbirds and insects and gathered by bees for making honey. This sweet liquid the main energy source for the colony. Pollen which the fine powdery material consisting of pollen grains that is produced by the anthers of seed plants. Melissopalynological analysis is still the prescribed method for botanical origin denomination and therefore it is one of the greatest discriminatory powers of honeys [3]. Some authors declare not only re-acidity and humidity especially important parameters, but in some cases pollen analysis is also of great meaning for the geographical origin and classification of honeys [4, 5, 6].

Honeybees visit various flowers of plant species, foraging for nectar and pollen grains. Honeybees play a vital role in making plant fertilization possible, as well as help in the conservation of biodiversity. When bees collect nectar from flowers, they obtain some quantity of pollen from the flower of the plant. After the nectar has been converted into honey in the hive, some of the pollen remains in the honey [7, 8, 9]. The pollen that is mixed in the honey is important for the honey's quality [10]. Geographic and botanical properties are important for the quality of honeys [11, 12].

The taste, smell and colour of honey changes according to the nectar of the flowers. Pollen analyses of floral honeys reveal the plant taxa of the honey's source. Honey is a complex mixture and presents very great variations in composition and characteristics due to its geographical and botanical origin [13, 14, 15]. All over the world, the last 50 years, increase in the cultivation of culture plants has increased the proportions of this plants polen [16] In addition, climatic changes can influence the overall process of pollination [17]. These factors may also have on effect on the pollen content of honey. Pollen analyses has become more popular in recent years, since characterization of honey is an important aspect in the development of beekeeping. Palynology studies are thus helpful in bee management and in development of beekeeping [18].

The goal of the present study, is to report the results of pollen analyses from 20 honey samples collected from Hizan district of Bitlis province, eastern region of Turkey. We hope this study results open a new window all of the Turkish honeys pollen analyses studies in future.

MATERIALS AND METHODS

Hizan is an east Anatolian district of Bitlis province and located mainly in B9 according to Davis' grid square system. The climate of the area bioclimatically has a humid, very cold, type of Mediterranean climate. The annual rainfall in the region is 605-1041 mm and average temperature is around 9 °C. The common soil types are limeless brown soils, alluvial soils and regosols. Phytogeographically the area is in the Irano-Turanian flora sector. The natural vegetation formation of the area is oak and juniper forest. *Quercus infectoria* Olivier subsp. *boissieri* (Reut.) is dominant taxon in this vegetation at altitudes of 1300-2200 m. *Q. libani* Olivier accompanies *Q. infectoria* in some places. *Juniperus* L. is a subdominant species widely distributed in the area. However some parts of the forest have been destroyed and degenerated in various ways. Hence the anthropogenic steppes are widespread on the mountain area where natural forests are destroyed.

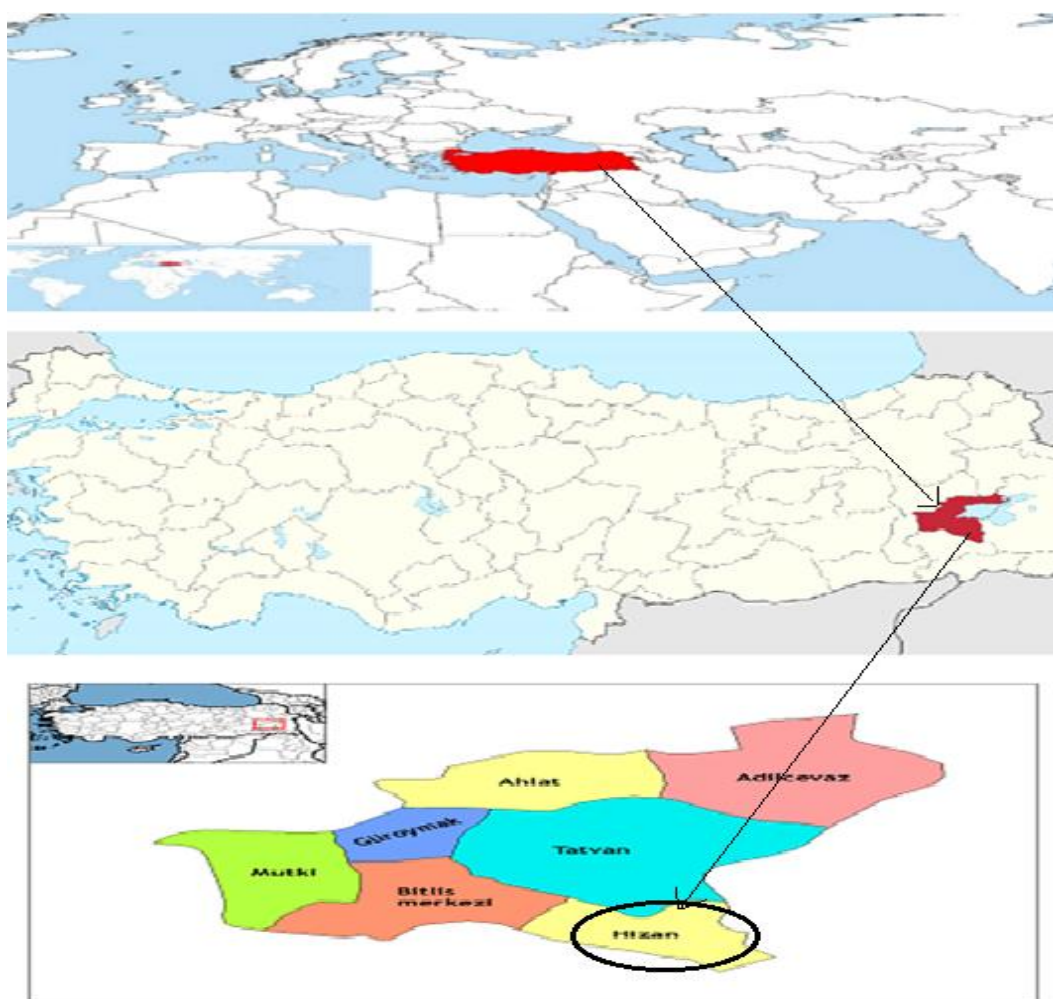


Figure 1. The geographical map of Hizan district of Bitlis province.

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Hizan district of Bitlis province is an important plant area, a key biodiversity area and a high priority area for protection where is surrounded with high mountains reaching to approximate 3000 m elevation (Figure 2). The geology of the area is also very complex and diverse. Diversity of geology and climate provides very diverse habitats for flora and fauna. Therefore there are many plant species peculiar to this area (Figure 2). A study on the flora and the vegetation of the Hizan district of Bitlis province revealed that there are 627 vascular plant taxa belonging to 303 genera and 77 families were determined of which 49 species are endemic to Turkey; in this research the largest families based on their taxa are *Asteraceae* (109), *Fabaceae* (101), *Poaceae* (77), *Lamiaceae* (65), *Brassicaceae* (53) and the richest genera are *Trifolium* L. (27), *Astragalus* L. (22) and *Silene* L. (18) [19].

Hizan has favourable climate and vegetation for beekeeping in summer periods. There are thousands of hectares of oak and juniper forests as well as wild flowers belong to *Fabaceae*, *Asteraceae*, *Lamiaceae*, *Poaceae*, *Caryophyllaceae*, *Scrophulariaceae*, *Apiaceae*, *Liliaceae*, *Rosaceae*, *Brassicaceae*, *Boraginaceae*, *Chenopodiaceae* families; *Astragalus*, *Trifolium*, *Silene* genera and others. A lot of honey bee colonies are brought to the region by migratory beekeepers from different regions for honey production in the summer.

20 honey samples were collected randomly from villages of the Hizan district of Bitlis province (Figure 1). Honey samples were collected from beekeepers in the region where beekeeping activities exists.

Pollen analysis was done using the methods defined by Louveaux et al. [20]. The pollen identification and observations were made with an Olympus light microscope (400× or 1000× as appropriate). Pollen types were identified by personal reference and based on the relevant literature. Pollen grains were counted on 2 slides for each honey sample and each pollen types was presented as a percentage with respect to the total counted pollen grains numbers [21, 22, 23]. The amount of pollen ranging: between 19% and 39% was considered as the major group, between 6% and 12% was considered as the minor group, between 1% and 3% was considered as the trace group.



Figure 2. Some photos from study area of Hizan district of Bitlis province.

RESULTS

On the analysis of the samples taken from 20 different localities, it was found that *Fabaceae* and *Asteraceae* pollen appeared in every one of the samples (Table 1).

Honey sample 1 from Kocyigit village contained a high percentage of pollen grains from *Fabaceae* (36%) and *Asteraceae* (21%). *Fabaceae* pollen grains were forming *Onobrychis* genus pollen grains (8%). *Boraginaceae* (8%), *Brassicaceae* (9%), and *Rosaceae* (10%) were present in this sample while *Apiaceae* (2%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23].

Honey sample 2 from Kocyigit village contained a high percentage of pollen grains from *Fabaceae* (35%) and *Asteraceae* (22%). *Fabaceae* pollen grains were forming *Onobrychis* genus pollen grains (11%). *Boraginaceae* (10%), *Brassicaceae* (8%), and *Rosaceae* (7%) were present in this sample while *Apiaceae* (2%) and *Chenopodiaceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23].

Honey sample 3 from Kocyigit village contained a high percentage of pollen grains from *Fabaceae* (33%) and *Asteraceae* (22%). *Fabaceae* pollen grains were form *Onobrychis* genus pollen grains 9 %. *Rosaceae* (12%), *Brassicaceae* (11%) and *Boraginaceae* (6%) were present in this sample while *Apiaceae* (2%), *Ericaceae* (1%), *Lamiaceae* (1%) and *Chenopodiaceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23].

Honey sample from Atlı village contained a high percentage of pollen grains from *Fabaceae* (35%) and *Asteraceae* (20%). *Fabaceae* pollen grains were form *Onobrychis* genus pollen grains 6%. *Rosaceae* (12%), *Brassicaceae* (10%) and *Boraginaceae* (8%) were present in this sample while *Apiaceae* (3%) and *Asteraceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23].

Honey sample from Hecter village contained a high percentage of pollen grains from *Fabaceae* (32%) and *Asteraceae* (25%). *Fabaceae* pollen grains were form *Onobrychis* genus pollen grains 10%. *Brassicaceae* (10%), *Rosaceae* (9%) and *Boraginaceae* (9%) were present in this sample while *Apiaceae* (2%), *Chenopodiaceae* (1%) and *Asteraceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23].

Honey sample 1 from Panur village contained a high percentage of pollen grains from *Fabaceae* (36%) and *Asteraceae* (24%). *Rosaceae* (14%), *Brassicaceae* (10%) and *Boraginaceae* (5%) were present in this sample while *Asteraceae* (3%), *Apiaceae* (3%), *Chenopodiaceae* (1%) and *Lamiaceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23]. Honey sample 2 from Panur village contained a high percentage of pollen grains from *Fabaceae* (31%) and *Asteraceae* (25%). *Fabaceae* pollen grains were form *Onobrychis* genus pollen grains 9%. *Rosaceae* (10%), *Brassicaceae* (10%) and *Boraginaceae* (6%) were present in this sample while *Apiaceae* (3%), *Ericaceae* (1%) and *Lamiaceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23].

Honey sample 3 from Panur village contained a high percentage of pollen grains from *Fabaceae* (36%) and *Asteraceae* (21%). *Fabaceae* pollen grains were form *Onobrychis* genus pollen grains 10%. *Brassicaceae* (10%), *Rosaceae* (8%) and *Boraginaceae* (7%) were present in this sample while *Apiaceae* (3%) and *Chenopodiaceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23].

Honey sample from Ballı village contained a high percentage of pollen grains from *Fabaceae* (34%) and *Asteraceae* (24%). *Fabaceae* pollen grains were form *Onobrychis* genus pollen grains 10%. *Rosaceae* (10%), *Boraginaceae* (9%) and *Brassicaceae* (7%) were present in this sample while *Apiaceae* (2%), *Ericaceae* (1%), *Lamiaceae* (1%) and *Asteraceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23]. Honey sample from Hecter Mountain contained a high percentage of pollen grains from *Fabaceae* (35%) and *Asteraceae* (22%). *Fabaceae* pollen grains were forming *Onobrychis* genus pollen grains 10%. *Rosaceae* (12%), *Boraginaceae* (8%) and *Brassicaceae* (8%) were present in this sample while *Apiaceae* (2%) and *Ericaceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23].

Honey sample from Yukarı Ayvacık village contained a high percentage of pollen grains from *Fabaceae* (34%) and *Asteraceae* (20%). *Fabaceae* pollen grains were forming *Onobrychis* genus pollen grains 12%. *Boraginaceae* (10%), *Brassicaceae* (10%) and *Rosaceae* (9%) were present in this sample while *Apiaceae* (2%) and *Chenopodiaceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23]. Honey sample from Gayda village contained a high percentage of pollen grains from *Fabaceae* (35%) and *Asteraceae* (23%). *Fabaceae* pollen grains were form *Onobrychis* genus pollen grains 12%. *Brassicaceae* (9%), *Boraginaceae* (8%) and *Rosaceae* (8%) were present in this sample while *Apiaceae* (3%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23].

Table 1: Samples of Hizan district of Bitlis province honeys and their botanical origin

Study area	Major families (% pollen)	Minor families and genus (% pollen)	Trace family or genus (% pollen)
1. Kocuyigit Village N: 38 12 823 E: 04 22 10 16 Alt.: 1753 m	36% Fabaceae 21% Asteraceae	10% Rosaceae 8% Fabaceae- <i>Onobrychis</i> sp. 8% Boraginaceae- <i>Echium</i> sp. 9% Brassicaceae	2% Apiaceae
2. Kocuyigit Village N: 38 12 823 E: 04 22 08 77 Alt.: 1763 m	35% Fabaceae 22% Asteraceae	11% Fabaceae- <i>Onobrychis</i> sp. 10% Boraginaceae- <i>Echium</i> sp. 8% Brassicaceae 7% Rosaceae	2% Apiaceae 1% Chenopodiaceae- <i>Chenopodium</i> sp.
3. Kocuyigit Village N: 38 12 820 E: 04 22 09 55 Alt.: 1766 m	33% Fabaceae 22% Asteraceae	12% Rosaceae 11% Fabaceae- <i>Onobrychis</i> sp. 9% Brassicaceae 6% Boraginaceae- <i>Echium</i> sp.	2% Apiaceae 1% Ericaceae 1% Lamiaceae 1% Chenopodiaceae- <i>Chenopodium</i> sp.
4. Atli Village N: 38 12 818 E: 04 22 09 64 Alt.: 1764 m	35% Fabaceae 20% Asteraceae	12% Rosaceae 10% Brassicaceae 8% Boraginaceae- <i>Echium</i> sp. 6% Fabaceae- <i>Onobrychis</i>	3% Apiaceae 1% Asteraceae- <i>Centaurea</i> sp.
5. Hecter Village N: 38 12 819 E: 04 22 09 64 Alt.: 1765 m	32% Fabaceae 25% Asteraceae	10% Brassicaceae 10% Fabaceae- <i>Onobrychis</i> sp. 9% Boraginaceae- <i>Echium</i> sp. 9% Rosaceae	2% Apiaceae 1% Chenopodiaceae- <i>Chenopodium</i> sp. 1% Asteraceae- <i>Centaurea</i>
6. Panur Village N: 38 12 821 E: 04 22 09 55 Alt.: 1767 m	36% Fabaceae 24% Asteraceae	14% Rosaceae 10% Brassicaceae 5% Boraginaceae- <i>Echium</i> sp.	3% Asteraceae- <i>Centaurea</i> sp. 3% Apiaceae- <i>Bifora</i> sp. 1% Lamiaceae 1% Chenopodiaceae- <i>Chenopodium</i> sp.
7. Panur Village N: 38 12 819 E: 04 22 08 69 Alt.: 1779 m	31% Fabaceae 25% Asteraceae	10% Rosaceae 10% Fabaceae- <i>Onobrychis</i> sp. 9% Brassicaceae 6% Boraginaceae- <i>Echium</i>	2% Apiaceae 1% Ericaceae 1% Lamiaceae
8. Panur Village N: 38 12 773 E: 04 22 07 63 Alt.: 1794 m	36% Fabaceae 21% Asteraceae	10% Fabaceae- <i>Onobrychis</i> sp. 10% Brassicaceae 8% Rosaceae 7% Boraginaceae- <i>Echium</i>	3% Apiaceae 1% Chenopodiaceae- <i>Chenopodium</i> sp.
9. Balli Village N: 38 12 852 E: 04 22 05 09 Alt.: 1870 m	34% Fabaceae 24% Asteraceae	10% Rosaceae 10% Fabaceae- <i>Onobrychis</i> sp. 9% Brassicaceae 7% Boraginaceae- <i>Echium</i> sp.	2% Apiaceae 1% Ericaceae 1% Lamiaceae 1% Asteraceae- <i>Centaurea</i> sp.
10. Hecter Mountain N: 38 12 852 E: 04 22 04 56 Alt.: 1789 m	35% Fabaceae 22% Asteraceae	12% Rosaceae 10% Fabaceae- <i>Onobrychis</i> sp. 8% Brassicaceae 8% Boraginaceae- <i>Echium</i> sp.	2% Apiaceae 1% Ericaceae
11. Yukari Aycacik Village N: 38 13 214 E: 04 22 00 69 Alt.: 2019m	34% Fabaceae 20% Asteraceae	12% Fabaceae- <i>Onobrychis</i> sp. 10% Brassicaceae 10% Boraginaceae- <i>Echium</i> 9% Rosaceae	2% Apiaceae 1% Chenopodiaceae- <i>Chenopodium</i> sp.
12. Gayda Village N: 38 13 393 E: 04 22 48 24 Alt.: 1489 m	35% Fabaceae 17% Asteraceae	12% Rosaceae 10% Boraginaceae- <i>Echium</i> sp. 8% Fabaceae- <i>Onobrychis</i> sp. 8% Brassicaceae	3% Apiaceae 1% Chenopodiaceae- <i>Chenopodium</i> sp.
13. Keklik Village N: 38 13 401 E: 04 22 47 98 Alt.: 1483 m	39% Fabaceae 21% Asteraceae	12% Rosaceae 11% Fabaceae- <i>Onobrychis</i> sp. 9% Brassicaceae 6% Boraginaceae- <i>Echium</i> sp.	2% Apiaceae 1% Ericaceae 1% Lamiaceae 1% Chenopodiaceae- <i>Chenopodium</i> sp.
14. Kopsuyu Village N: 38 13 789 E: 04 22 47 98 Alt.: 1485 m	38% Fabaceae 19% Asteraceae	10% Boraginaceae- <i>Echium</i> sp. 10% Fabaceae- <i>Onobrychis</i> sp. 9% Brassicaceae 9% Rosaceae	3% Apiaceae 1% Chenopodiaceae- <i>Chenopodium</i> sp.
15. Altmoluk Village N: 38 13 415 E: 04 22 45 47 Alt.: 1497 m	37% Fabaceae 21% Asteraceae	10% Brassicaceae 10% Fabaceae- <i>Onobrychis</i> sp. 9% Boraginaceae- <i>Echium</i> sp. 8% Rosaceae	2% Apiaceae 1% Lamiaceae
16. Gokcimen Village N: 38 13 397 E: 04 22 43 45 Alt.: 1509 m	37% Fabaceae 21% Asteraceae	10% Brassicaceae 10% Fabaceae- <i>Onobrychis</i> sp. 9% Boraginaceae- <i>Echium</i> sp.	2% Apiaceae 1% Chenopodiaceae- <i>Chenopodium</i> sp.
17. Akdik Village N: 38 13 690 E: 04 22 27 56 Alt.: 1798 m	39% Fabaceae 22% Asteraceae	10% Brassicaceae 10% Fabaceae- <i>Onobrychis</i> sp. 9% Boraginaceae- <i>Echium</i> sp.	2% Apiaceae 1% Chenopodiaceae- <i>Chenopodium</i> sp.
18. Harman Duven Village N: 38 13 824 E: 04 22 27 10 Alt.: 1901m	36% Fabaceae 21% Asteraceae	10% Brassicaceae 8% Boraginaceae- <i>Echium</i> sp. 8% Fabaceae- <i>Onobrychis</i> sp.	2% Apiaceae 1% Chenopodiaceae- <i>Chenopodium</i> sp.
19. Erencik Village N: 38 13 861 E: 04 22 47 12 Alt.: 1926 m	32% Fabaceae 30% Asteraceae	10% Fabaceae- <i>Onobrychis</i> sp. 9% Boraginaceae- <i>Echium</i> 8% Rosaceae 6% Brassicaceae	2% Apiaceae 1% Lamiaceae
20. Ekinli Village N: 38 13 789 E: 04 22 27 31 Alt.: 1869 m	39% Fabaceae 22% Asteraceae	10% Fabaceae- <i>Onobrychis</i> sp. 9% Boraginaceae- <i>Echium</i> 7% Rosaceae 7% Brassicaceae	3% Apiaceae

Honey sample from Keklik village contained a high percentage of pollen grains from *Fabaceae* (39%) and *Asteraceae* (17%). *Fabaceae* pollen grains were from *Onobrychis* genus pollen grains 8%. *Rosaceae* (12%), *Boraginaceae* (10%) and *Brassicaceae* (8%) were present in this sample while *Apiaceae* (3%) and *Chenopodiaceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23]. Honey sample from Kopsuyu village contained a high percentage of pollen grains from *Fabaceae* (38%) and *Asteraceae* (19%). *Fabaceae* pollen grains were from *Onobrychis* genus pollen grains 10%. *Boraginaceae* (10%), *Rosaceae* (9%) and *Brassicaceae* (9%) were present in this sample while *Apiaceae* (3%) and *Chenopodiaceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23]. Honey sample from Altmoluk village contained a high percentage of pollen grains from *Fabaceae* (37%) and *Asteraceae* (21%). *Fabaceae* pollen grains were from *Onobrychis* genus pollen grains 10%. *Brassicaceae* (10%), *Boraginaceae* (9%) and *Rosaceae* (8%) were present in this sample while *Apiaceae* (2%) and *Lamiaceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23].

Honey sample from Gokcimen village contained a high percentage of pollen grains from *Fabaceae* (37%) and *Asteraceae* (21%). *Fabaceae* pollen grains were from *Onobrychis* genus pollen grains 11%. *Brassicaceae* (8%), *Boraginaceae* (8%) and *Rosaceae* (8%) were present in this sample while *Apiaceae* (2%) and *Chenopodiaceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23].

Honey sample from Akdik village contained a high percentage of pollen grains from *Fabaceae* (39%) and *Asteraceae* (22%). *Fabaceae* pollen grains were from *Onobrychis* genus pollen grains 8%. *Brassicaceae* (9%), *Boraginaceae* (9%) and *Rosaceae* (8%) were present in this sample while *Apiaceae* (2%) and *Chenopodiaceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23].

Honey sample from Harman Doven village contained a high percentage of pollen grains from *Fabaceae* (38%) and *Asteraceae* (23%). *Fabaceae* pollen grains were from *Onobrychis* genus pollen grains 8%. *Brassicaceae* (10%) and *Boraginaceae* (8%) were present in this sample while *Apiaceae* (2%) and *Chenopodiaceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23]. Honey sample from Erencik village contained a high percentage of pollen grains from *Fabaceae* (32%) and *Asteraceae* (30%). *Fabaceae* pollen grains were from *Onobrychis* genus pollen grains 10%. *Boraginaceae* (9%), *Rosaceae* (8%) and *Brassicaceae* (6%) were present in this sample while *Apiaceae* (2%) and *Asteraceae* (1%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23].

Honey sample from Ekinli village contained a high percentage of pollen grains from *Fabaceae* (39%) and *Asteraceae* (22%). *Fabaceae* pollen grains were from *Onobrychis* genus pollen grains 10%. *Boraginaceae* (9%), *Rosaceae* (7%) and *Brassicaceae* (7%) were present in this sample while *Apiaceae* (3%) pollen grains were present in trace amounts (Table 1). After melissopalynological analysis, it was clear that this honey sample should be declared as a multifloral [23].

Pollen grains of 9 families were identified in 20 samples of honey from study areas (Figure 1). The pollen analysis revealed that all of honey samples multifloral (Table 2).

Table 2: Frequency classes for pollen types in selected honey samples from the Hizan district of Bitlis province

MEMBERS OF MAJOR FAMILY	TOTAL TAXA	AVERAGE %
Fabaceae	710	35.5
Asteraceae	454	22.7
Fabaceae - <i>Onobrychis</i> sp.	182	9.1
Boraginaceae - <i>Echium</i> sp.	165	8.25
Brassicaceae	trace	trace
Apiaceae	43	2.15
Asteraceae - <i>Centaurea</i> sp.	trace	trace
Chenopodiaceae - <i>Chenopodium</i> sp.	trace	trace
Lamiaceae	trace	trace
Ericaceae	trace	trace
<i>Chenopodium</i> sp.	trace	trace

DISCUSSION

Pollen is very important for honeybee nutrition [24, 25]. Honeybees collect pollen grains from entomophilous and anemophilous plants to obtain protein for their survival and reproduction [26, 27]. The bees frequently collect a wide variety of pollen types, but they generally concentrate on a few species [28, 29]. The pollen composition of the honeys studied revealed important information on the flora of the region. This study is the first melissopalynological report about honey from Hizan district of Bitlis province. The 20 honey samples are multiflora. 9 plant families were identified in the 20 honey samples. In each sample, *Fabaceae* and *Asteraceae* mostly represented indicating that the bees frequently visit these families. These plant families play important role in honey production.

The pollen analyses of the honeys collected from Hizan district of Bitlis province generated significant information pertaining to geographic and botanical origins of honeys and documentation of bee foraging of plants, as well. The quantification of the pollen types in relation to their overall distribution in the local flora brings knowledge of the principles and importance of the forage plants for each honey sample. According to Kaya et al. [5]. Pollen grains in the dominant and secondary groups supply the nectar source, which play a crucial role in the formation of honey, while the taste, smell and colour of honey change according to the flower nectar, as in our present study.

According to the results, pollen grains of families Fabaceae and Asteraceae were dominant in all samples. Akyalcin et al. [30] reported that the size of pollen grains of genus Asteraceae show wide variations. However, all of the other identified pollen grains that are mixed in the honey still significantly influence the quality of the honey. According to Lieux [31], many of the pollen grains of this group have been mixed into the honey in a random fashion.

Our results suggest that Hizan district of Bitlis province honeys are mostly mixed and contains give a great variability for characteristics of honeys. The results suggest that pollen in honey originates from several wild plants. Therefore Hizan district of Bitlis province honeys are a typically nectar honey and nectar originates from several plants flowering from spring to autumn. Therefore Hizan district of Bitlis province honeys could be described as very good nectariferous plants.

There are some similar studies done in our neighbouring countries. Therefore, we need to compare our results with studies, the Mediterranean region can be described rich or moderately rich in pollen and concentrations are mostly (~ 90 % of cases) more than 10.000 pollen grains per gram of honey [32, 33, 34, 6].

Our results of Hizan district of Bitlis province honeys revealed also very rich samples. Pollen analysis of Hizan district of Bitlis province honey samples showed a wide variety of botanical sources. The pollen types of wild growing plants are derived from typical Hizan district of Bitlis province flora [19].

The results showed that the pollen types of Fabaceae and Asteraceae were the most abundant among the samples. The pollen of Boraginaceae, Brassicaceae, Rosaceae, Apiacea, Lamiacea, Ericacea and Chenopodiaceae were also present.

The pollen concentration values of Hizan district of Bitlis province honeys ranges from 100 to 84.000 values. The analytical data obtained in this research may be useful in the future studies concerning the characterisation and properties of Turkey honeys. The present study gives new information about regional plant sources for honey pollen. The powerfull of the current study was that most of samples were obtained directly from beekeepers. Therefore, we have evaluated the floral origin of the honey by means of hive location and available floral source. Further studies should also consider this aspect.

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