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Chemical and Palynological Properties of Ayder (Camlihemsin/Rize) Honeys

Ayder (Çamlıhemşin/Rize) Ballarının Kimyasal ve Palinolojik Özellikleri

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Abstract

Total number of pollen, pollen recognition, fructose, glucose, sucrose and moisture were examined in 41 honey samples collected in Ayder Plateau in August 2012. Following the pollen recognition in the samples, 36 taxa were detected. Castanea sativa Miller. pollen was found in all samples in a dominant. The total number of pollen (TPN-10 g) in 10g honey varieted between 3438 and 87056. It has been determined that honey samples were normal and dominant pollen. The moisture content in the samples ranged between 16.4-20.9%. In honey samples, fructose ranges from 14.05 to 52.82%, while glucose ranges from 14.31 to 49.24%.

Keywords: Ayder Plateu, Honey, Pollen analysis, TPN-10g, Sugar analysis

Özet

Ayder Yaylası'nda Ağustos 2012'de toplanan 41 bal örneğinde toplam polen sayısı, polen tanıma, fruktoz, glukoz, sükroz ve nem bakıldı. Örneklerde polen tanılamanın ardından 36 takson tespit edildi. *Castanea sativa* Miller. polen örneklerinin tamamında baskın olarak bulunmuştur. 10 gram baldaki toplam polen sayısı (TPN-10 g) 3438 ile 87056 arasında çeşitlenmiştir. Bal örneklerinin normal ve baskın polen olduğu belirlenmiştir. Numunelerdeki nem içeriği %16.4-20.9 arasında değişmiştir. Bal örneklerinde fruktoz %14.05 ile %52.82 arasında, glukoz ise %14.31 ile %49.24 arasında değişmektedir.

Anahtar Kelimeler: Ayder yaylası, Bal, Polen analizi, TPS-10g, Şeker analizi

Abbreviations: TPN, Total Pollen Number.

1. INTRODUCTION

Pollen and nectar from plants provide the raw materials for the food of honeybees, and the collection and processing of these raw materials are executed by these insects in an exciting manner, exhibiting an intricate pattern of behavior. The plant preferences of the honeybees can be elucidated from pollen contained in the honey and also from pollen loads (denoting perhaps the plants visited for pollen collection alone). Moreover, the bee pollen load analysis indicates the behavioral pattern and sense of selection of plants for food (Sharma & Abrol, 2005).

Ayder Plateau, with natural beauties, authentic architecture of the region and scientifically proven thermal spa, which has been proven to be healing for many diseases, has become the center of attention of local and foreign tourists. Also, its attractiveness increased with the Heliski sport, which was realized for the first time in our country in 2004. The Ayder Plateau is located on the left branch of the Firtina Valley and covers subalpine-alpine bushes and meadows at 1500-2300 m altitude (Figure 1). On the other hand, since the alpine belt consists of rash areas, it is relatively poor in terms of floristry (Demir & Atamov, 2019).

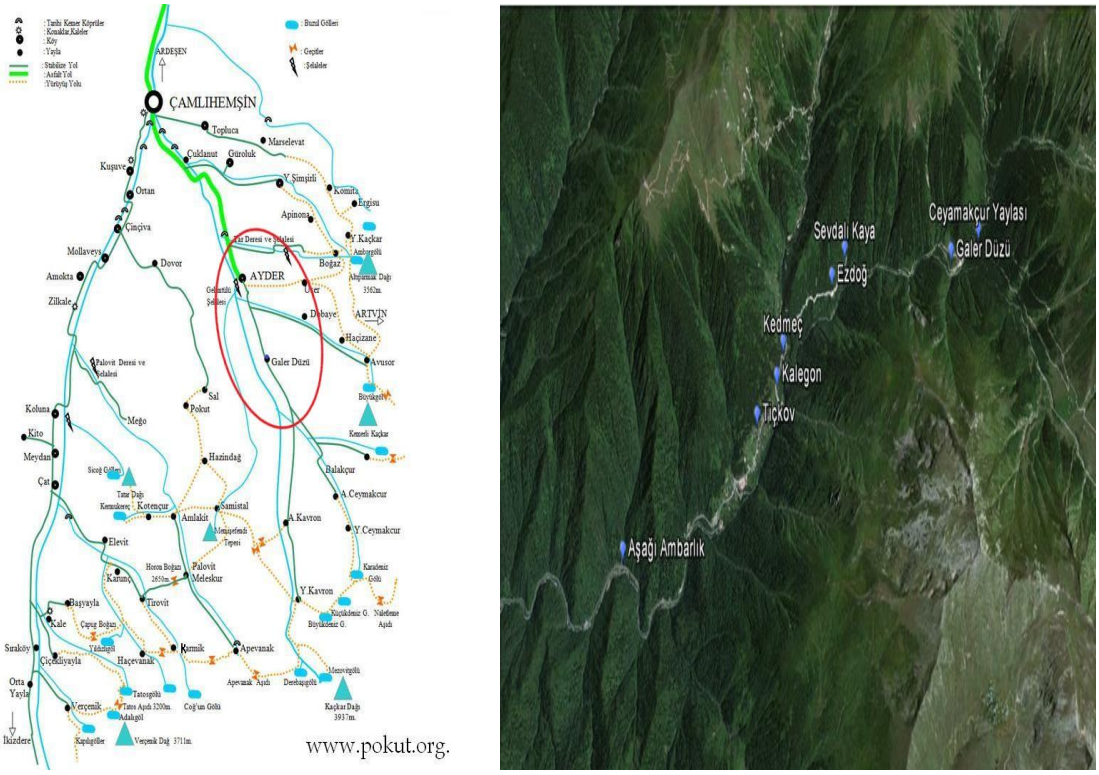

Figure 1. Ayder Plateau location and stations where samples were collected (Anonymous, 2022)

Typically, the verification of the geograpical origin of honey is realized by analysis of the pollen (mellisopalinology) in honey (Çelemli et al., 2021). This method is based on the identification of pollen by microscopic analyses. It requires an expert, it is very time consuming

and dependent on the expert's ability and judgments (Howels, 1969). Other methods that could be more widely used for characterizing honey have been sought for many years (Radovic et al., 2001).

This study was aimed to determine chemical and palynological properties of Ayder Plateau honey samples.

2. MATERIALS and METHODS

In this study, pollen analysis was performed on 41 honey samples collected in 2011 from hives in 8 different regions in Ayder Plateau and Galer Düzü locations. In addition, the pollen spectrum of the samples and the total number of pollen (TNP-10 g) was examined, moisture content and sugar analyses were also performed.

The honey samples were collected from different beehives in the month of July-August in 2011. During the field studies, herbarium materials were collected. Reference pollen slides were made from the herbarium materials.

The preparation of the honey samples was done using the method defined by the International Bee Research Association (Oddo et al., 2004). Preparations were made from each honey sample for identification of pollen. After identification, 200 pollen samples were counted in each preparation. Source books (Aytug et al., 1971; Sorkun, 2008), reference pollen slides were used during the pollen analyses. Nikon Eclipse E100 microscope was used for the analyses. Total pollen number (TPN-10g) analyses was done according to (Sorkun, 2007).

The amount of moisture in honey samples stored at 20 °C was measured with portable refractometer.

3. RESULTS and DISCUSSION

The average amount of TPN-10 is higher in honey samples collected from the Asagı Ambarlik, Tickov and Kalegon localities. The presence of *Castanea sativa* Miller. in these regions caused the total number of pollens to be high (Figure 2).

As a result of determining the amount of TPN-10 in 41 samples collected from different regions in Ayder Plateau, the total number of pollen in 10 g honey was found to be the lowest in the honey sample 34 and the highest in the sample 12 (Table 1). As a result of the determination of the amount of TPN-10 in 41 samples collected from different regions in Ayder Plateau, the total number of pollen in 10 g honey value was determined to be the minimum 3.438 in sample 34 and the maximum value was determined to be 87.056 in sample 12. Bayram

et. al. (2019) determined TPN values of 10 grams of honey between 16.024 and 90.126 in Bayburt Honeys. Ozler (2018) reported that TPN-10 values ranged from 332 to 42.496. The total number of pollen in 10 g honey value was determined to be the minimum 3.438 in sample 34 and the maximum value was determined to be 87.056 in sample 12. Çelemli et al. (2021) reported nearly same results.

Sorkun and Sahin (2000) reported that starch from pollen can be found in honey and this is a natural result. No starch grains were found in any of the 41 samples we collected.

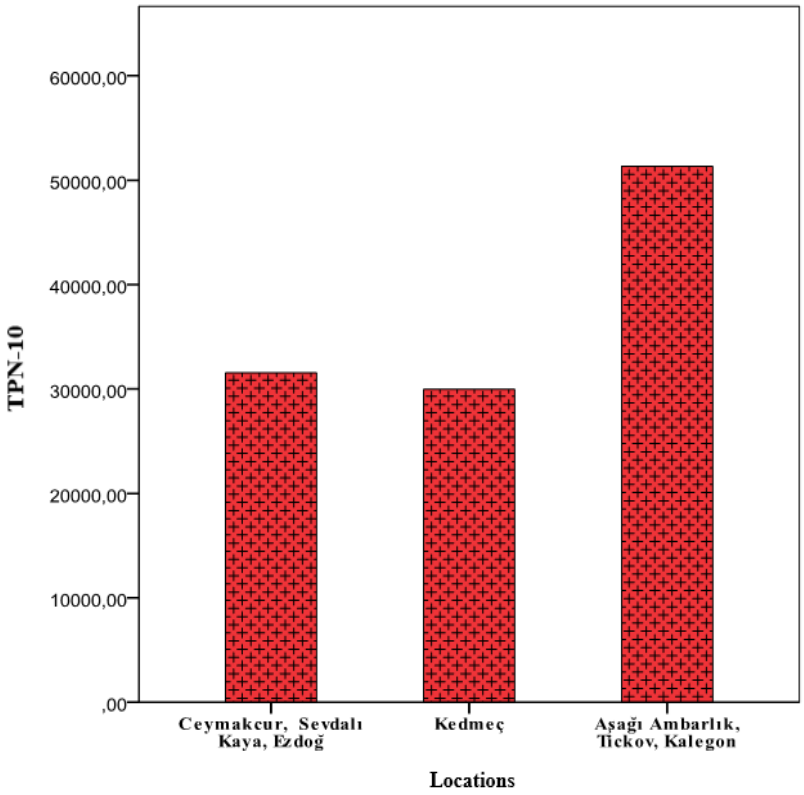

Figure 2. Average amounts of TPN-10 g according to the regions where the honey samples were collected

Table 1. Collected Area, TPN-10 g Values, Pollen Spectrum (*Dominant pollen,**Secondary Pollen,***Minor Pollen,****Rare Pollen)

Sample No	**Collected Area**	**TPN-10 g**	**Pollen Spectrum** ***(*Dominant pollen,**Secondary Pollen,***Minor Pollen,****Rare Pollen)***
1	Tickov	27.225	* *Castanea sativa* ** - *** Brassicaceae, Fabaceae, Rosaceae **** Rosaceae, Fabaceae, Boraginaceae, Ericaceae, Caryophyllaceae, Pinaceae, *Onobrychis* sp., *Zea mays* ve *Carex* sp.

2	Tickov	15.050	* *Castanea sativa* ** - *** Brassicaceae, Boraginacea,Fabaceae **** Rosaceae, Ericaceae, Apiaceae, Chenepodiaceae, *Rumex* sp., *Onobrychis* sp., *Carex* sp., *Tilia* sp.
3	Kedmec	25.635	* *Castanea sativa* ** - *** Fabaceae **** Scrophulariaceae, Rosaceae, Brassicaceae, Ericaceae, Asteraceae, *Myosotis* sp.
4	Kedmec	21.135	* *Castanea sativa* ** - *** Brassicaceae, Ericaceae, Fabaceae **** Apiaceae, Rosaceae, Boraginaceae, *Salix* sp., *Rumex* sp., *Carex* sp., Liliaceae, Poaceae, Caryophyllaceae, Unidentified
5	Tickov	26.174	* *Castanea sativa* ** - *** Ericaceae, Rosaceae **** Brassicaceae, Rutaceae, Fabaceae, Caryophyllaceae, Boraginaceae, *Salix* sp., *Gentiana* sp.
6	Tickov	15.926	* *Castanea sativa* ** - *** Rosaceae, Brassicaceae, Ericaceae **** -
7	Kedmec	5.806	* *Castanea sativa* ** - *** Brassicaceae **** Rosaceae, Fabaceae, Ericaceae, Caryophyllaceae, *Salix* sp., *Onobrychis* sp., *Lotus* sp., *Myosotis* sp.
8	Kedmec	27.218	* *Castanea sativa* ** - *** Ericaceae, Rosaceae, Brassicaceae **** Fabaceae, Boraginaceae, Geraniaceae, Pinaceae, *Onobrychis* sp.
9	Kedmec	22.489	* *Castanea sativa* ** - *** Rosaceae, Brassicaceae **** Fabaceae, Ericaceae, Boraginaceae, Cistaceae, *Carex* sp., *Myosotis* sp.
10	Asagi Ambarlik	50.168	* *Castanea sativa* ** - *** - **** Ericaceae, Rosaceae

11	Asagi Ambarlik	54.908	* *Castanea sativa* ** - *** Ericaceae, Rosaceae **** Brassicaceae, Boraginaceae , Apiaceae, *Carex* sp., Unidentified
12	Asagi Ambarlik	87.056	* *Castanea sativa* ** - *** Ericaceae ve Rosaceae **** Brassicaceae, Caryophyllaceae, *Tilia* sp., *Gentiana* sp.
13	Kedmec	33.808	* *Castanea sativa* ** - *** Ericaceae **** Brassicaceae, Rosaceae
14	Sevdali Kaya	15.392	* *Castanea sativa* ** - *** Rosaceae, Brassicaceae, Ericaceae **** Pinaceae, Rhamnaceae, Fabaceae, Poaceae, *Verbascum* sp. , *Rumex* sp., *Geranium* sp.
15	Asagi Ambarlik	69.197	* *Castanea sativa* ** - *** Ericaceae **** Brassicaceae, Rosaceae, Unidentified
16	Tickov	53.303	* *Castanea sativa* ** - *** Rosaceae, Ericaceae ****Boraginaceae, Fabaceae, Apiaceae, Cistaceae, *Anchusa* sp.Brassicaceae, *Campanula* sp.
17	Asagi Ambarlik	14.109	* *Castanea sativa* ** - *** Ericaceae **** Rosaceae, Brassicaceae, Boraginaceae, Fabaceae, *Salix* sp., *Campanula* sp.
18	Kedmec	52.258	* *Castanea sativa* ** - *** Rosaceae **** Fabaceae, Cistaceae, Scrophulariaceae, Ericaceae, Asteraceae, Cyperaceae, Brassicaceae, *Rumex* sp., *Myosotis sp.*, *Onobrychis sp.*,Unidentified
19	Ceymakcur	35.172	**Castanea sativa* ** - *** Rosaceae, Brassicaceae, Ericaceae, Unidentified **** Scrophulariaceae, *Rumex* sp.

20	Kedmec	85.285	**Castanea sativa* ** - *** - ****Boraginaceae, Brassicaceae, Fabaceae, Rosaceae, Ericaceae, *Rumex* sp., *Vicia* sp.,
21	Kedmec	26.477	**Castanea sativa* ** *** Rosaceae, Brassicaceae, Ericaceae, Unidentified **** Pinacaea, *Salix* sp.
22	Kedmec	25.557	**Castanea sativa* ** - *** Rosaceae, Ericaceae **** Cistaceae, Chenepodiaceae, Scrophulariaceae, Amaryllidaceae, Brassicaceae, *Veronica* sp.
23	Kalegon	54.683	**Castanea sativa* ** - *** Brassicaceae ****Scrophulariaceae, Asteraceae, Lamiacaea, Fabaceae, Ericaceae, Cistaceae, *Salix* sp., *Primula* sp., *Ranunculus* sp.
24	Kedmec	29.323	**Castanea sativa* ** - *** - **** Ericaceae, Poaceae, Brassicaceae, Fabaceae, Caryophyllaceae, Rosaceae, *Rumex* sp., Unidentified
25	Kedmec	40.441	**Castanea sativa* ** - *** - **** Rosaceae, Ericaceae, ,Brassicaceae, Fabaceae, Ranunculaceae, *Gentiana* sp., Unidentified
26	Kedmec	21.645	**Castanea sativa* ** - *** - ****Rosaceae, Ericaceae, Poaceae, Brassicaceae, Fabaceae, Boraginaceae, Scrophulariaceae *Carex* sp.
27	Kedmec	12.723	**Castanea sativa* ** - *** Rosaceae, Ericaceae ****Cistaceae, Brassicaceae, Scrophulariaceae, Asteraceae, Caryophyllaceae
28	Sevdali Kaya	5. 073	** Castanea sativa* ** - *** Brassicaceae, Ericaceae

			**** Rosaceae, Cucurbitaceae, Cistaceae, Fabaceae, Boraginaceae, *Laurus nobilis*, Unidentified
29	Kedmec	44.265	* *Castanea sativa* ** Brassicaceae *** Rosaceae **** Ericaceae, *Geranium* sp., *Primula* sp.,*Verbascum* sp., *Myosotis* sp.
30	Kedmec	52.631	* *Castanea sativa* ** - *** Rosaceae, Ericaceae **** Brassicaceae, Boraginaceae, *Salix* sp., Unidentified
31	Ezdog	18.982	* *Castanea sativa* ** - *** Brassicaceae **** Rosaceae, Ericaceae, Apiaceae, Cucurbitaceae, Fabaceae, Pinaceae, Caryophyllaceae, Boraginaceae, *Carex* sp., *Tilia* sp., Unidentified
32	Kedmec	34.325	* *Castanea sativa* ** - *** Brassicaceae **** Scrophulariaceae, Rosaceae, Ericaceae
33	Kedmec	7.862	* *Castanea sativa* ** - *** Brassicaceae, Ericaceae **** Rosaceae, Boraginaceae, Lamiaceae, Apiaceae, Fabaceae, Pinaceae, Poaceae, Caryophyllaceae, Asteraceae, *Geranium* sp., *Ranunculus* sp.,
34	Kedmec	3.438	**Castanea sativa* ** - ***Brassicaceae, Scrophulariaceae **** Fabaceae, Lamiaceae, Boraginaceae, Asteraceae, *Onobrychis* sp., *Rumex* sp.
35	Ezdog	34.354	**Castanea sativa* ** - ***Ericaceae, Rosaceae ****Fabaceae, Boraginaceae,Caryophyllaceae, Brassicaceae, Asteraceae, *Carex* sp., *Rumex* sp., *Geranium* sp., Unidentified
36	Ezdog	79.977	**Castanea sativa* ** - *** Ericaceae ve Rosaceae ****Fabaceae, Boraginaceae, Lamiaceae, Brassicaceae, Apiaceae, Chenepodiaceae, *Zea mays*, *Carex* sp.

37	Ezdog	51.897	**Castanea sativa* ** - *** Ericaceae, Brassicaceae, Rosaceae ****Lamiaceae, Chenepodiaceae, Liliaceae, Pinaceae, Fabaceae, Boraginaceae, *Zea mays*, *Rumex* sp., *Salix* sp.,*Carex* sp.
38	Kedmec	27.444	**Castanea sativa* ** - ***Brassicaceae **** Ericaceae, Chenepodiaceae,Rosaceae, Fabaceae, *Carex* sp.
39	Kedmec	28.725	**Castanea sativa* ** - *** Ericaceae, Rosaceae, Fabaceae ****Malvaceae, Apiaceae, Brassicaceae, Chenepodiaceae, Liliaceae, Cistaceae, *Rumex* sp., *Onobrychis* sp., *Laurus nobilis*, Unidentified
40	Kedmec	30.892	**Castanea sativa* ** - *** Rosaceae and Ericaceae ****Scrophulariaceae, Brassicaceae, Apiaceae, Liliaceae, Chenepodiaceae, Lamiaceae, Boraginaceae, *Onobrychis* sp., *Zea mays*, *Rumex* sp., *Laurus nobilis*, Unidentified
41	Asagi Ambarlik	29.122	**Castanea sativa* ** - *** - ****Brassicaceae, Boraginaceae, Fabaceae, Rosaceae, Cistaceae, Scrophulariaceae, Lamiaceae

Fructose was calculated between 14.05 % and 65.28 % in honey samples. Glucose changed between 14.31-67.47 %. F/G was found between 0.76-1.6. According to the Turkish Food Codex Honey Commission (2020/7), the amount of Fructose + Glucose should be at least 60g per 100g. In our study, Fructose was calculated between 14.05- 68.25% in honey samples. Sajwani et al. (2007) found the amount of fructose of honey samples to be between 19.40-40.75% in their study. The current study glucose changed between 14.31-67.47 %. Ouchmoukh et al. (2007) reported fructose amount 35.99-42.57% and glucose value was found to be between 26.23-34.38%.

While Demir Kanbur et al. (2021) found fructose amount to be an average of 45,38 in their study, the average fructose amount was 29 in our study. Fructose is responsible for many nutritional and physical characteristics of honey. The rate of fructose is determined by the variety of floral sources from which honey samples are originated (Sajwani et.al., 2007).

Glucose, high temperature and storage conditions accelerate crystallization in honey. In honey samples, F/G ratio changed between 0.76 and 1.6 (Figure 3). Moisture value was over the Honey Standards commission (2020/7) in one sample, while 13 samples were calculated below the honey standard (Figure 4).

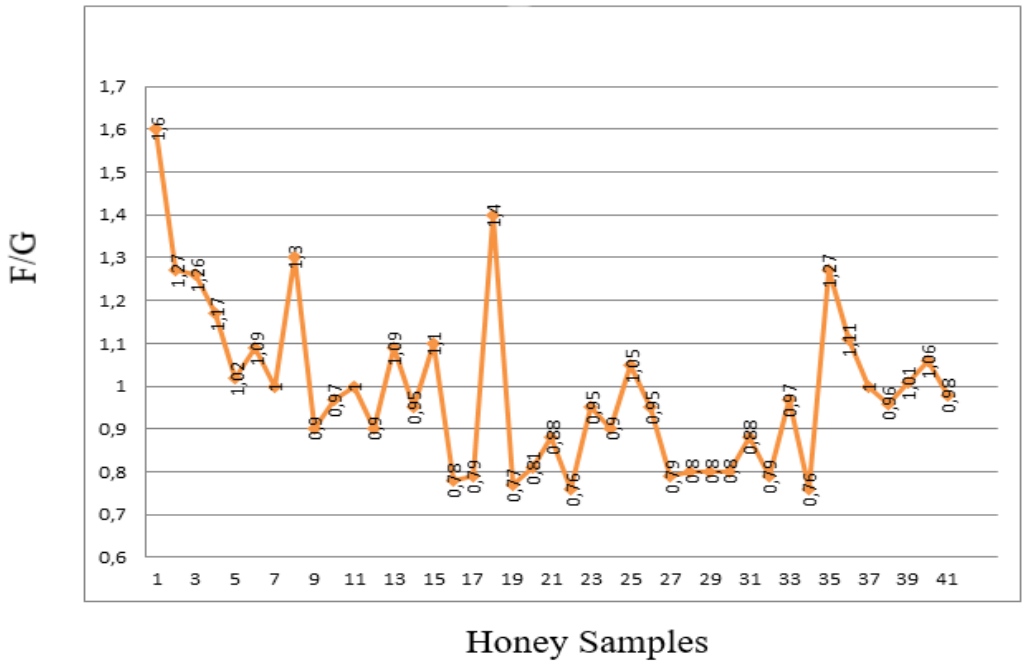

Figure 3. F/G ratios of honey samples

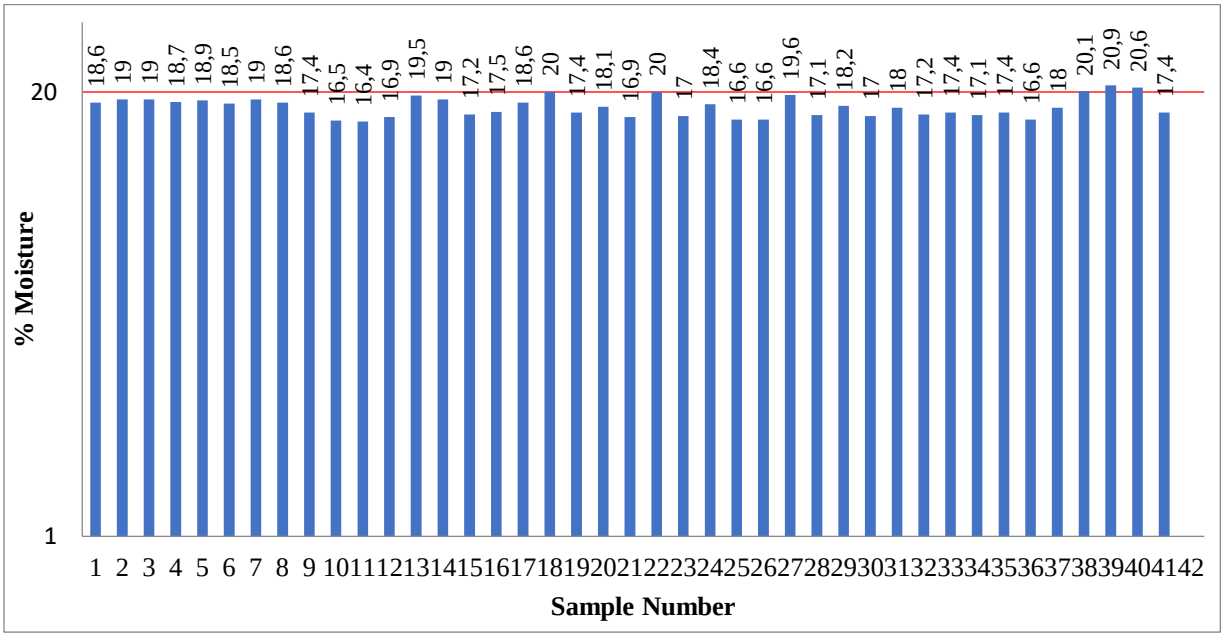

Figure 4. Moisture contents of honey samples

The moisture percentage was high in samples 39 and 40 respectively 20.9 and 20.6. According to the Turkish Food Codex Honey Commission (2020/7), the moisture percentage

was high in samples 39 and 40. There is an increased chance of fermentation in honey with a water ratio higher than 18.5 (Bolukbasi, 2009).

Castanea sativa pollen (Figure 5) was detected dominantly in all honey samples. Pollen belonging to Brassicaceae family was found in a single sample in a secondary amount. While Brassicaceae pollen was not found in sample 10, minor or trace amounts were encountered in all other samples. Secondary and trace amounts of pollen were not found in one sample. Pollen belonging to the Rosaceae family was not found only in the sample 34. While pollen belonging to Ericaceae family was not found in honey samples 34 and 41, it was found in minor or trace amounts in other honey samples. The pollen of Lamiaceae family was found in seven honey samples. During honey pollen analysis, a maximum of 14 taxa were detected, while at least 3 taxa were detected in honey samples. These taxa were *Castanea sativa*, Ericaceae and Rosaceae. Fabaceae pollen was determined in the minor and rare categories. Celemli et al. (2021), reported nine out of twenty samples as chestnut honey in Ayder Plateau. Erdogan (2007) found that *Castanea sativa* pollen is dominant in 25 of 65 samples. Bayram and Demir (2018) reported that C*astanea sativa* pollen is dominant in t Rize and Giresun province. 5 samples were identified as unifloral honey. Bayram (2019) identified *Castanea sativa* and *Astragalus* sp. pollen at dominant rates. Çam (2006) reported that Rosaceae is the most common pollen species in honey samples. In addition, Taşkın (2006) found Rosaceae pollen in 14 of 20 samples in his study. In addition to nectar and pollen yield, bees prefer Rosaceae family more due to its high number of taxa.

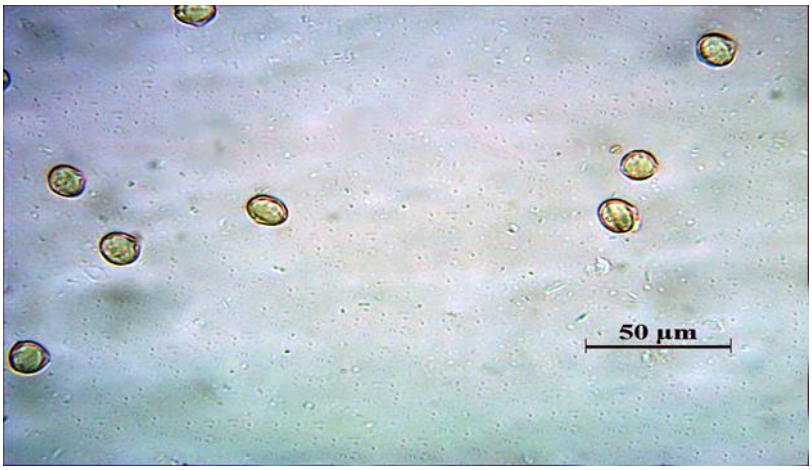

Figure 5. *Castanea sativa* pollen

4. CONCLUSION

In this study, melissopalinological and some chemical analyses of 41 honey samples collected from Ayder Plateau were conducted. Honeybees have preferred to collect *Castanea*

sativa Ericaceae, Chenepodiaceae, Rosaceae, Fabaceae, *Carex* sp. Malvaceae, Apiaceae, Brassicaceae, Chenepodiaceae, Liliaceae, Cistaceae, *Rumex* sp., *Onobrychis* sp., *Laurus nobilis* Scrophulariaceae, Lamiaceae, Boraginaceae, *Onobrychis* sp., *Zea mays*, Asteraceae, *Geranium* sp. pollens. *Castanea sativa* pollen was found to be dominant in all honey samples.

The intensive tourism in Ayder Plateau is negatively affected the floristic structure. Increasing human population and vehicle traffic cause environmental pollution. This affects the bee population and honey yield. For this reason, although there are no broad-leaved woody plants in Ayder Plateau, it has been determined that honeybees fly long distances and reach chestnut flowers. While this is tiring for the bee, the honey yield decreases.

DECLARATIONS

All authors declare that they have no conflicts of interest.

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