MELLIFERA RESEARCH ARTICLE

Melissopalynological Analysis of Honey Samples Belonging to Different Districts of Sinop, Turkey

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ABSTRACT

Based on pollen analysis, honey samples of 21 different localities in Boyabat, Durağan, Erfelek, Gerze, Saraydüzü and Türkeli districts of Sinop were investigated. The honey samples were collected in 2013 from local beekepers. All the honey samples investigated were classified as multifloral. The dominant group of pollen grains were *Castanea sativa* Miller and Fabaceae family. The pollen grains belonging to 61 taxa were identified of which 19 were in family, 1 was in tribe, 36 were in genus and 5 were in species level. TPN-10g was ranged from 11 534 to 1 538 787.

Key words: Melissopalynology, multifloral honey, TNP-10g, cluster analysis, Sinop.

Introduction

Turkey has a rich and interesting floristic structure. It has more than 10 000 plant species of which naturally or culturally grown and nearly 450 species are nectary plants and these are known to be important in apiculture [1]. Bees sometimes collect only nectar from plants, sometimes only pollen and sometimes both pollen and nectar. Bees collect pollen to feed themselves and their larvae. The plant or bees derived compounds such as carbohydrates, amino acids, acetylcholine, water, vitamin, mineral, flavonoids, organic acids, pollen, pigments, beeswax and enzyme constitute content of honey. Besides pollen analysis in honey (melissopalynology) helps to identify origin of geographical region where it was produced and floristic structure of honey and it also helps to determine the range of nectar types used to produce a honey. One way of determining the quality and classification of honey is through pollen analysis. The pollen content is one of the factors affecting the quality of honey. If honey is adulterated with sugar syrup, this could be distinguished by decreasing amount of the pollen.

In recent years, many researchers have carried out melissopalynological analysis in Turkey [2–11] and other countries [12–20].

Sinop is situated in the Western Black Sea region and in terms of plant geography it is in the Euxine province of Euro-Siberian floristic area of Turkey. In terms of flora and vegetation it has interesting features. It is influenced by Oceanic climate and there are some old Mediterranean enclaves in the region [21].

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This study aims to reveal groups of plants that bees use as sources of nectar and pollens in the content of honey samples in Sinop region. It also aimes to teach beekeepers groups of nectar rich plants for better production.

Material and Methods

21 natural honey samples were collected from Boyabat, Durağan, Erfelek, Gerze, Saraydüzü and Türkeli districts of Sinop in the year 2013 (Figure 1). For pollen analysis of honey samples, the method which was recommended by the International Bee Research Association [22] and followed by Sorkun and Doğan [23]. For identification of pollen grains of honey samples reference slides, palynological literature, books and atlases were utilized [1,4,17,24–30].

The counting and identification of pollen grains were made by Nikon Eclipse E 100 microscope and microphotographs were taken under a Leica DM750. Microphotographs of pollen grains from the honey samples were shown in Figures 2 and 3. The pollen grains were divided into four groups; I- Rare group (<3%), II-Minor group (3%-15%), III-Secondary group (16%–44%), and IV-Dominant group (>45%). TPN-10g is used for distinguishing between artificial and natural honeys. Accordingly, based on the TPN-10g (total number of pollen in 10g of honey), the pollen grains were classified into 5 categories; Category I (<20 000), Category II (20 000–100 000), Category III (100 000–500 000), Category IV (500 000–1 000 000), and Category V (>1 000 000) (Figure 4). The term of multifloral honey is used for pollens of multiple taxa.

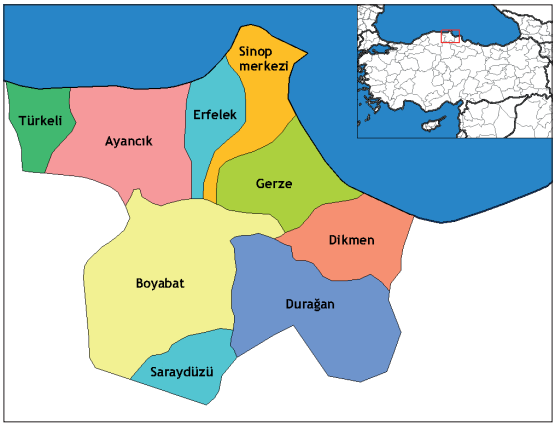

Figure 1. The map showing the study area.

To classify and find the similarities between the 21 honey samples according to their pollen taxa, a cluster analysis (Euclidean's hierarchical cluster method) was applied [31]. For this method, Statistically Package for the Social Sciences (SPSS 21) was used (Figure 5). In the dendrogram obtained from analysis, two large clusters were generated. Both clusters were divided into subgroups. The first large cluster includes the stations Türkeli and Erfelek and the second includes Durağan, Saraydüzü, Boyabat and Gerze (Figure 5).

Results and Discussion

In the present study, melissopalynological analysis were done in 21 honey samples belonging to different districts of Sinop. A total of 61 taxa were identified, including 47 entomophilous pollen taxa (e.g., Rosaceae, Labiatae, *Echium*) and 6 anemophilous pollen taxa (e.g., *Pinus*, Gramineae, Cupressaceae, Chenopodiaceae / Amaranthaceae). Of these taxa, 19 were in family, 1 was in tribe, 36 were in genera and 5 were in species level (Table 1). All of the honey samples investigated were classified as multifloral. Dominant pollen group consists of Fabaceae in samples 2–5 and 16 whereas it consists of *Castanea sativa* Miller from family Fagaceae in samples 9–14, 17–21. In samples 1, 6, 7, 8 and 15, there was no group of dominant pollen grains. TNP-10g values range from 11 534 to 1 538 787. While the highest number of TPN-10g was in Sample 6,

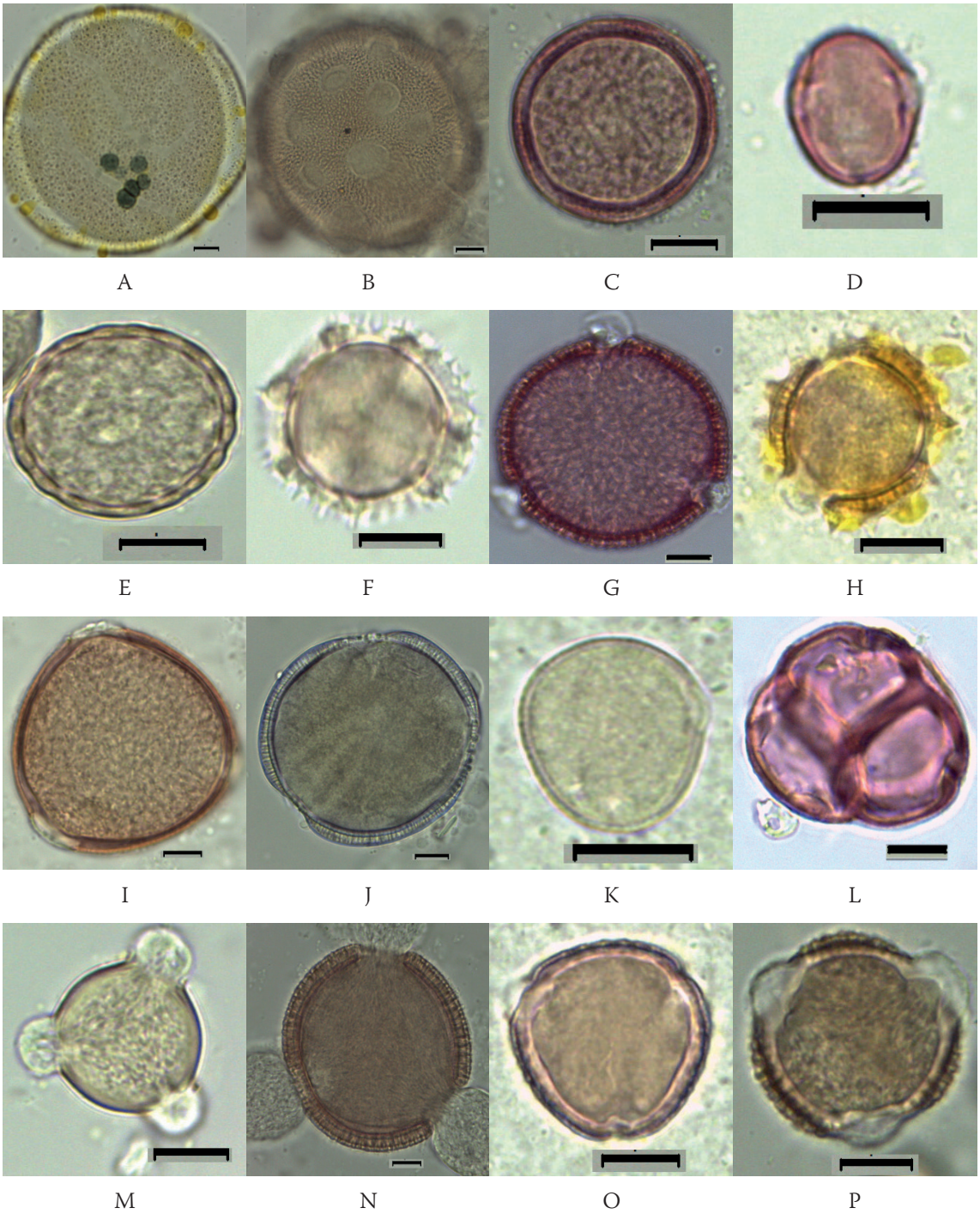

Figure 2. Microphotographs of selected taxa of honey samples. A. *Berberis* sp. B. *Calystegia* sp. C. Caryophyllaceae D. *Castanea sativa* E. Chenopodiaceea-Amaranthaceae F. Cichorieae G. *Cistus salviifolius* H.Compositae I. *Cornus* sp. J. *Convolvulus* sp. K. *Echium* sp. L. *Erica* sp. M. Fabaceae N. *Geranium* sp. O. *Hedera helix* P. *Ilex* sp. (Scale bar 10μm).

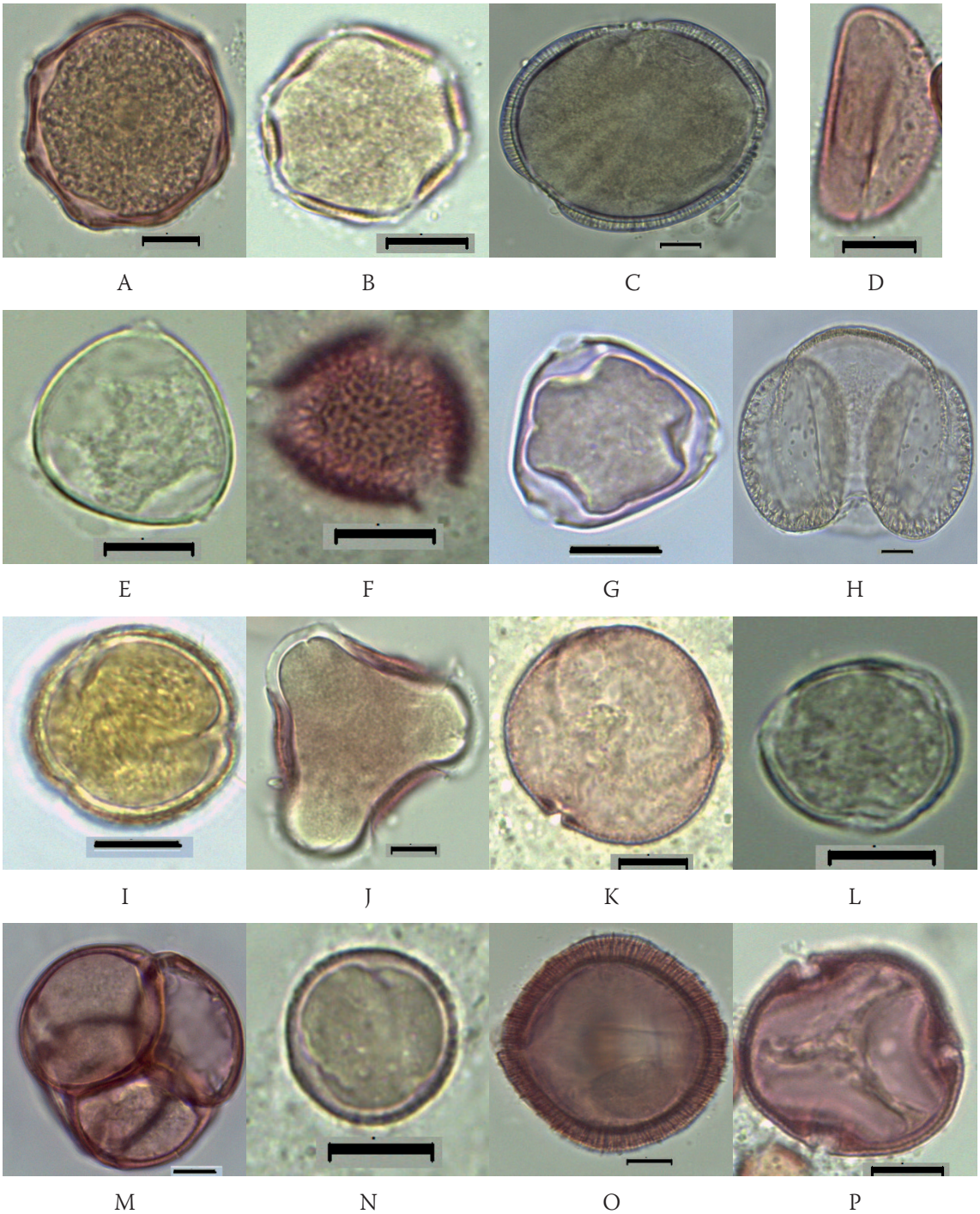

Figure 3. Microphotographs of selected taxa of honey samples. A. *Juglans* sp. B. Labiatae C. *Linum* sp. D. Liliaceae E. *Morus* sp. F. Oleaceae G. *Paliurus spina-christii* H. *Pinus* sp. I. *Quercus* sp. J. Rosaceae K. *Rumex* sp. L. Ranunculaceae M. *Rhododendron* sp. N. *Salix* sp. O. *Scabiosa* sp. P. *Tilia* sp. (Scale bar 10μm).

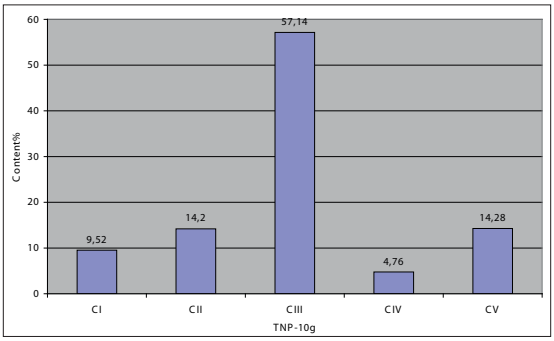

Figure 4. Percentage rate of TNP-10g in honey samples. CI (<20 000 pollen grains) found in 2 samples, CII (20 000–100 000 pollen grains) found in 3 samples, CIII (100 000–500 000 pollen grains) found in 12 samples, CIV(500 000–1 000 000 pollen grains) found in 1 sample, CV (>1 000 000 pollen grains) found in 3 samples.

the lowest was in Sample 11 (Table 1). Based on TNP-10g, percentage rate of pollens were shown in Category I (CI) as 9.5%, in Category II (CII) as 14%, in Category III (CIII) as 57%, in Category IV (CIV) as 5%, and in Category V (CV) as 14% (Figure 4).

Castanea sativa Miller is a quite common species and element of the flora for districts of Erfelek and Türkeli. Similarly, Fabaceae is a group of dominant pollen which is compatible with floristic composition [21,32–35]. Secondary pollen group was represented by *Salix* sp., Fabaceae (Sample 1), Rosaceae (Sample 4), *Salix sp.*, Fabaceae, Brasssicaeae and *Echium* sp. (Sample 8), Fabaceae and Ranunculaceae (Samples 9 and 15). The minor

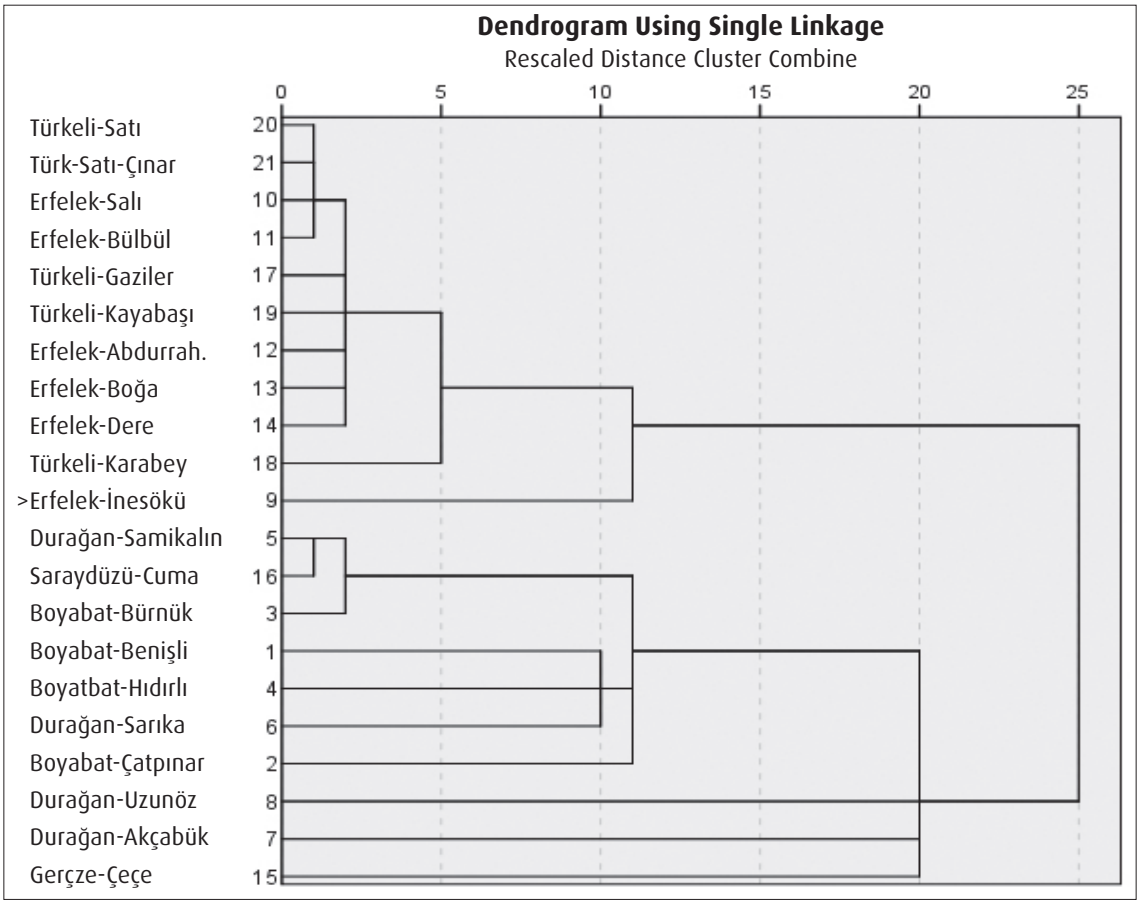

Figure 5. Dendrogram of cluster analysis.

Table 1. Pollen types identified, their spectra and TNP-10 g values from the honey samples

Number of Samples	Locality	Pollen spectra	TNP-10g
1	Boyabat-Benişli plateau	* - **_Salix_ sp., Fabaceae ***_Cistus_ sp., Brassicaceae, Labiatae, _Hedera helix_ L., _Echium_ sp., Scrophulariaceae ****_Fumana_ sp., Boraginaceae, _Rumex_ sp., _Paliurus spina-christi_ Miller, Umbelliferae, _Quercus_ sp., Compositae, Cichorieae, _Pinus_ sp., Gramineae, Ranunculaceae, _Rhododendron_ sp., _Linum_ sp., _Morus_ sp., _Euphorbia_ sp., _Plantago_ sp., _Populus_ sp., _Carex_ sp.	46 735
2	Boyabat-Çatpınar village	*Fabaceae **- ***Labiatae, _Cistus_ sp., _Echium_ sp. ****_Fumana_ sp., Rosaceae, Gramineae, Chenopodiaceae/Amaranthaceae, Rubiaceae, Compositae, Caryophyllaceae, _Campanula_ sp., Ranunculaceae, _Salix_ sp., Quercus sp.	167 022
3	Boyabat-Bürnük	*Fabaceae **- ***_Echium_ sp. ****Labiatae, Compositae, _Centaurea_ sp., Chenopodiaceae/Amaranthaceae, Brassicaceae, _Convolvulus_ sp., Rosaceae, _Campanula_ sp., Gramineae, _Pinus_ sp., _Salix_ sp., _Plantago_ sp., Cupressaceae, _Juglans_ sp.	1 099 667
4	Boyabat-Hıdırlı plateau	*Fabaceae **Rosaceae ***_Salix_ sp., Brassicaceae ****Umbelliferae, Gramineae, Ranunculaceae, Labiatae, _Rhododendron_ sp., _Berberis_ sp., Boraginaceae, _Echium_ sp., _Campanula_ sp., _Sarcopoterium spinosum_ (L.) Spach, _Xanthium_ sp., Cichorieae, Compositae, _Centaurea_ sp., _Cistus_ sp., _Pinus_ sp., Gentianaceae, _Quercus_ sp., Oleaceae	437 000
5	Durağan-Samikalınca	*Fabaceae **- ***- ****Rosaceae, Plantago, Labiatae, _Pinus_ sp., _Cistus_ sp., Oleaceae, _Xanthium_ sp., _Paliurus spina-christi_ Miller, Umbelliferae, Brassicaceae, Gramineae, _Convolvulus_ sp., _Echium_ sp., _Rhododendron_ sp.	378 075

Number of Samples	Locality	Pollen spectra	TNP-10g
6	Durağan-Sarıkadı village	*- ** Fabaceae *** Cichorieae, Boraginaceae, *Echium* sp., Rosaceae, *Hedera helix* L. ****_Plantago_ sp., _Xanthium_ sp., Compositae, Caryophyllaceae, _Pinus_ sp., _Sarcopoterium spinosum_ (L.) Spach, _Smilax_ sp., _Quercus_ sp., _Convolvulus_ sp., _Morus_ sp., _Berberis_ sp., Labiatae, Chenopodiaceae/Amaranthaceae, Gramineae, Umbelliferae, Brassicaceae, _Salix_ sp., _Rhododendron_ sp., _Cistus_ sp., _Geranium_ sp., Gentianaceae, _Paliurus spina- christi_ Miller	1 538 787
7	Durağan-Akçabük village	*- **_Salix_ sp., Ranunculaceae ***_Rhododendron_ sp., _Quercus_ sp., Rosaceae ****Fabaceae, _Juglans_ sp., Compositae, Boraginaceae, Gramineae, _Corylus_ sp., _Cistus_ sp., _Carpinus_ sp., _Paliurus spina-christi_ Miller, _Pinus_ sp., Labiatae, _Morus_ sp., Brassicaceae, _Rumex_ sp.	181 115
8	Durağan-Uzunöz village	*- **_Salix_ sp., Fabaceae, Brassicaceae, _Echium_ sp. ***Umbelliferae, _Castanea sativa_ Miller, _Cistus_ sp. ****Scrophulariaceae, Oleaceae	17 138
9	Erfelek-İncemeydan, İnesökü	*Castanea sativa Miller **Fabaceae, Ranunculaceae ***Rosaceae ****_Smilax_ sp., _Cornus_ sp., _Echium_ sp., _Pinus_ sp., _Paliurus spina-christi_ Miller, _Plantago_ sp., _Sambucus_ sp., _Rumex_ sp., Compositae, Gramineae, Oleaceae, _Cistus_ sp., Quercus, _Sarcopoterium spinosum_ (L.) Spach, Brassicaceae, _Salix_ sp., _Populus_ sp.	205 051
10	Erfelek-Salı village, Sökü neighborhood	*_Castanea sativa_ Miller **- ***Fabaceae, Quercus, Labiatae ****Ranunculaceae, Rosaceae, Gramineae	97 337
11	Erfelek-Bülbül neighborhood	* _Castanea sativa_ Miller **- ***Fabaceae ****_Echium_ sp., Boraginaceae, Scrophulariaceae, Rosaceae, Gramineae, _Smilax_ sp., _Salix_ sp., _Urtica_ sp., Oleaceae	11 534

Number of Samples	Locality	Pollen spectra	TNP-10g
12	Erfelek-between Abdurrahmanpaşa-Atbaşı village	* *Castanea sativa* Miller **- ***Fabaceae, Rosaceae, Ranunculaceae ****_Sarcopoterium spinosum_ (L.) Spach, Liliaceae, Brassicaceae, Scrophulariaceae, _Echium_ sp., Labiatae, Umbelliferae, _Erica_ sp., _Paliurus spina-christi_ Miller, _Plantago_ sp., _Salix_ sp., _Cornus_ sp. L., _Smilax_ sp., _Pinus_ sp., Oleaceae, Gramineae, _Cistus_ sp., Compositae, _Xanthium_ sp., Cichorieae, _Ailanthus_ sp.	181 115
13	Erfelek-Boğa neighborhood	* _Castanea sativa_ Miller ** *** Fabaceae, _Cornus_ sp. ****_Pinus_ sp., Brassicaceae, Gramineae, Labiatae, _Cistus_ sp., _Hedera helix_ L., Liliaceae, _Echium_ sp., _Quercus_ sp., Scrophulariaceae, _Salix_ sp., Ranunculaceae, _Juglans_ sp., Rosaceae, _Smilax_ sp., Oleaceae, _Paliurus spina-christi_ Miller, _Xanthium_ sp., Cichorieae, _Acer_ sp., _Morus_ sp., Umbelliferae, _Plantago_ sp.	225 542
14	Erfelek-Dere village	* _Castanea sativa_ Miller **- *** _Cornus_ sp., Rosaceae **** Gramineae, Liliaceae, _Salix_ sp., _Plantago_ sp., _Acer_ sp., Labiatae, _Echium_ sp., _Fabaceae, Cistus_ sp., _Pinus_ sp., _Paliurus spina-christi_ Miller, Caryophyllaceae, Ranunculaceae, _Sarcopoterium spinosum_ (L.) Spach, _Smilax_ sp., Brassicaceae, Cichorieae	445 774
15	Gerze-Çeçe village	*- **Fabaceae, Ranunculaceae ***_Echium_ sp., Rosaceae ****Boraginaceae, _Salix_ sp., _Hedera helix_ L., Gramineae, Compositae, Cichorieae, Oleaceae, _Sarcopoterium spinosum_ (L.) Spach, Labiatae, _Cistus_ sp., _Scabiosa_ sp., Umbelliferae, Chenopodiaceae/Amaranthaceae, Liliaceae, _Quercus_ sp.	1 187 204
16	Saraydüzü-Cumatabaklı village	*Fabaceae **- ***_Cistus_ sp. ****Rosaceae, _Eucalyptus_ sp., Brassicaceae, Gramineae, _Salix_ sp., Compositae, Caryophyllaceae, _Campanula_ sp., Umbelliferae, _Pinus_ sp., Oleaceae, Ranunculaceae, _Rumex_ sp., _Paliurus spina-christi_ Miller, Labiatae, Chenopodiaceae/Amaranthaceae, Cupressaceae, _Sarcopoterium spinosum_ (L.) Spach, _Morus_ sp.	100 878

Number of Samples	Locality	Pollen spectra	TNP-10g
17	Türkeli-Gaziler	**Castanea sativa* Miller **- ***Fabaceae, *Salix* sp., *Cistus* sp. *****Plantago* sp., *Geranium* sp., Ranunculaceae, *Juglans* sp., *Smilax* sp., Brassicaceae, Gramineae, Rosaceae, *Sarcopoterium spinosum* (L.) Spach, *Erica* sp., *Cornus* sp., Oleaceae, *Quercus* sp.	167 301
18	Türkeli-Karabey village	* *Castanea sativa* Miller **- ****Cistus* sp., *Salix* sp. ****Ranunculaceae, *Sarcopoterium spinosum* (L.) Spach, *Erica* sp., *Rhododendron* sp., *Smilax* sp., *Paliurus spina-christi* Miller, Cichorieae, Cyperaceae, *Plantago* sp., *Echium* sp., Oleaceae, *Ilex* sp., *Carpinus* sp., Cupressaceae, *Alnus* sp., Fabaceae, *Cornus* sp., *Geranium* sp., Umbelliferae, *Convolvulus* sp., *Rumex* sp., *Juglans* sp., Labiatae, *Pinus* sp., *Euphorbia* sp., Chenopodiaceae/Amaranthaceae, Gramineae, *Quercus* sp., *Sambucus* sp., Liliaceae, *Scabiosa* sp., Malvaceae	389 976
19	Türkeli-Kayabaşı village	* *Castanea sativa* Miller **- ****Cistus* sp., *Salix* sp. *****Cistus salviifolius* L., Gramineae, Rosaceae, *Sarcopoterium spinosum* (L.) Spach, *Erica* sp., *Rhododendron* sp., *Salix* sp., *Tilia* sp., *Quercus* sp., Fabaceae, *Polygonum* sp., Brassicaceae, *Scabiosa* sp., Oleaceae, *Campanula* sp., *Rumex* sp., Cyperaceae, Chenopodiaceae/Amaranthaceae, Labiatae, Ranunculaceae, *Juglans* sp., *Echium* sp., *Cornus* sp., *Pinus* sp., *Abies* sp., *Geranium* sp., *Plantago* sp., Compositae, Cichorieae, *Calystegia* sp., Caryophyllaceae	510 388
20	Türkeli-Satı village	* *Castanea sativa* Miller **- ***Fabaceae ****Rosaceae, Cupressaceae, *Rhododendron* sp., *Rumex* sp., Ranunculaceae, S*milax* sp., Labiatae, Chenopodiaceae/Amaranthaceae, *Tilia* sp., *Cistus* sp., *Geranium* sp., *Quercus* sp., *Cornus* sp., *Corylus* sp., Gramineae, *Echium* sp., *Pinus* sp., Compositae	108 076
21	Türkeli-Satı village, Çınar neighborhood	* *Castanea sativa* Miller **- ***Rosaceae ****Labiatae, *Sambucus* sp., Ranunculaceae, *Rhododendron* sp., *Plantago* sp., *Quercus* sp., Fabaceae, *Echium* sp., Liliaceae, Malvaceae, Gramineae, *Paliurus spina-christi* Miller, Chenopodiaceae/Amaranthaceae	97 337

* Dominant pollen, ** secondary pollen, *** minor pollen, **** rare pollen, TPN-total number of pollen in 10g of honey

and rare pollen groups were present in all honey samples. Kaya et al. [8] expressed that pollen grains of dominant and secondary groups were source of nectar for honey formation. The rare pollen groups were identified highest in samples 18 and 19. The variability of taxa is greatest in this group. The pollen and nectar of some plants such as *Rhododendron* is known to have toxic effect [36]. Pollen grains of *Rhododendron* were determined as a minor quantity in samples 4, 5, 6, 18, 19, 20 and 21.

In the dendrogram of obtained from the hierarchical cluster analysis, *Castanea sativa* Miller was the most common species in the first large cluster whereas the taxa of *Salix* sp., and Fabaceae were common in the second cluster (Figure 5).

Conclusions

The floral source of honey can vary due to seasonal climatic and ecological conditions. This study gives information about floristic composition and botanical characterization of honey from different sources in Sinop region. Besides, the most common plant taxa such as *Castanea sativa* Miller, Fabaceae, *Salix* sp., Rosaceae, Brassicaceae, *Echium* sp. and Ranunculaceae were main sources of pollen and nectar for honey production in the year 2013.

Acknowledments

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Sinop İlinin Farklı İlçelerine Ait Bal Örneklerinin Palinolojik Analizi

Öz: Sinop ili Boyabat, Durağan, Erfelek, Gerze, Saraydüzü ve Türkeli ilçelerinden temin edilen 21 adet bal örneğinde polen analizi yapılmıştır. Örnekler 2013 yılında bölgesel bal üreticilerinden temin edilmiştir. İncelenen örnekler multifloraldır. Dominant polen grupları *Castanea sativa* Miller ve Fabaceae familyasına aittir. 19'u familya, 1'i tribus, 36'sı cins, 5'i tür düzeyinde olmak üzere 61 taksona ait polen tanımlanmıştır. TPS-10g, 11 534 ile 1 538 787 arasında değişiklik göstermiştir.
Anahtar Kelimeler: Melissopalinoloji, multifloral bal, TPS-10g, kümeleme analizi, Sinop.

REFERENCES

[1] SORKUN, K (2008) Türkiye'nin Nektarlı Bitkileri, Polenleri ve Balları. Palme Yayıncılık 462; Ankara, 341 pp.

[2] SORKUN, K; GÜNER, A; VURAL, M (1989) Rize Ballarında Polen Analizi. Doğa Türk Botanik Dergisi, 13 (3): 547-554.

[3] CAKIR, H (1990). Balıkesir Yöresi Ballarında Dominant ve Sekonder Polenler. M. Sc. Thesis. Uludağ University; Bursa, 77 pp.

[4] GEMİCİ, Y (1991) İzmir Yöresi Ballarında Polen Analizi. Doğa Turk-Journal of Botany,15:291-296.

[5] KAPLAN, A (1993) Konya Yöresi Ballarında Polen Analizi. M. Sc. Thesis; Ankara University, Ankara, 68 pp.

[6] SILICI, S (2004) Physicochemical and palynological analysis of honey samples belonging to different regions of Turkey. Mellifera, 4(7): 44-50.

[7] YURTSEVER, N (2004) Kemaliye-Erzincan Yöresinde Üretilen Balların Mikroskobik, Kimyasal ve Organoleptik Analizleri ile Balın Fizikokimyasal Özelliklerinin Saptanması. M. Sc. Thesis; Hacettepe University, Ankara, 113 pp.

[8] KAYA, Z; BİNZET, R; ORCAN, N (2005) Pollen Analyses of Honeys From Some Regions in Turkey. Apiacta, 40: 10-15.

[9] ERDOĞAN, N; PEHLİVAN, S; DOĞAN, C (2006) Pollen Analysis of Honeys from Hendek-Akyazı and Kocaali Districts of Adapazarı Province (Turkey). Mellifera, 6 (10-12): 20-27.

[10] ERDOĞAN, N; PEHLİVAN, S; DOĞAN, C (2009) Pollen Analysis of Honeys from Sapanca- Karapürçek-Geyve and Taraklı Districts of Adapazarı Province (Turkey). Mellifera, 9(17): 9-18.

[11] DEMİR, E (2012) Pollen Analysis of Honey Samples from Komati (Çamlıhemşin) Plateau. Mellifera, 12(24): 11-16.

[12] LIEUX, M H (1972) A Melissopalynological Study of 54 Lousiana (USA) Honeys. Review of Palaeobotany and Palynology, 13: 95-124.

[13] MOAR, N T (1985) Pollen Analysis of New Zealand Honey. Journal of Agricultural Research, 28: 38-70.

[14] ANDRADA, A; VALLE A., ARAMAYO, E; LAMBERTO, S; CANTAMUTTO, M (1998) Pollen Analysis of Honey from the Austral Mountains Buenos Aires Province, Investigation Agraria. Produccio Y Protection Vegetales, 13 (3): 265-275.

[15] VALENCIA, R M; HORRERA, B; MOLNAR, T (2000) Pollen and Organoleptic Analysis of Honeys in Leon Province (Spain). Grana, 39: 133-140.

[16] SABO, M; POTOČNJAK, M; BANJARI, I; PETROVIĆ, D (2011) Pollen Analysis of Honeys from Varaždin Country, Croatia. Turk J Bot, 35:581-587.

[17] SONG, X-Y; YAO, Y-F; YANG, W-D (2012) Pollen Analysis of Natural Honey from the Central Region of Shanxi, North China. Plos One, 7(11): 1-11.

[18] ATANASSOVA, J; BOZİLOVA, E; TODOROVA, S (2004) Pollen Analysis of Honey from the Region of Three Villages in West Bulgaria. Phytologia Balcanica,10 (2-3): 247–252.

[19] ATANASSOVA, J; YURUKOVA, L; LAZAROVA, M (2012) Pollen and inorganic characteristics of Bulgarian unifloral honeys. Czech J Food Sci, 30: 520-526.

[20] PUUSEPP, L; KOFF, T (2014) Pollen Analysis of Honey from the Baltic Region, Estonia. Grana, 53(1): 54–61.

[21] KILINC, M; KARAER, F (1995) Sinop Yarımadasının Vejetasyonu. Turk J Bot, 19:107-124.

[22] LOUVEAUX, J; MAURIZIO, A; VORHWOHL, G (1970) Method of Melissopalynology. Bee World, 51: 125-138.

[23] SORKUN, K; DOĞAN, C (2002) The Importance of the Total Number of Pollen Types in 10g of Honey in Distinguishing between Natural Honey and Artificial Honey Produced in Turkey. Mellifera, 2(3): 34-38.

[24] ERDTMAN, G (1954) An Introduction to Pollen Analysis. Chronica Botanica Company; 239 pp.

[25] KAPP, R O; DAVIS O K; KING, J E (2000) Pollen and Spores. American Association of Stratigraphic Palynologists Foundation Publication; U.S.A. 279 pp.

[26] AYTUĞ, B (1971) İstanbul Çevresi Bitkilerinin Polen Atlası. İstanbul Üniversitesi Orman Fakültesi Yayınları; İstanbul, 330 pp.

[27] LEWIS, W H; VINAY, P; ZENGER, V E (1983) Airborne and Allergenic Pollen of North America. The John Hopkins University Press; Baltimore and London, 254 pp.

[28] FAEGRI, K; IVERSEN, J (1989) Textbook of Pollen Analysis. Wiley and Sons; New York, 328 pp.

[29] MOORE, D; WEBB, J A; COLLINSON, M E1(991) Pollen Analysis. Blackwell Scientific Publications; London, UK, 216 pp.

[30] PEHLİVAN, S (1995) Türkiye'nin Alerjen Polenler Atlası. Ünal Offset Matbaacılık Sanayi ve Ticaret Ltd. Şirketi; Ankara, 191 pp.

[31] NAIR, S; MEDDAH, B; AOUES, A (2013) Melissopalynological characterization of North Algerian Honeys. Foods, 2: 83-89.

[32] KARAER, F; KILINÇ, M (1993) Sinop Yarımadasının Florası. Turk J Bot, 17:5-20.

[33] KORKMAZ, H; ENGİN, A (2001) The Flora of Boyabat (Sinop) Dam and Its Environs. Turk J Bot, 25:397-435.

[34] BAYSAL, M (2008) Çangal ormanı (Sinop-Ayancık) Vasküler Bitkiler Florası. Ph. D. Thesis, Ankara University; Ankara, 324 pp.

[35] KETENOĞLU, O; TUG, G N; KURT, L (2010) An ecological and syntaxonomical overview of *Castanea sativa* and a new association in Turkey. Journal of Enviromental Biology, 31: 81-86.

[36] ÇETER, T; GÜNEY, K (2011) Orman Gülü ve Deli Bal. Uludağ Arıcılık Dergisi, 11:124-129.