



### Pollen analysis of honeys from Ardahan/Turkey

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#### Abstract

The pollen which contents of eleven samples of honey from different localities of the province Ardahan, (Northeast Anatolia) are examined. The examples have the pollen grains of 23 different taxa from 13 families. The number 2 have the most abundant pollen content (7890 pollen grains; 20.07 %); the number 4 (6480 pollen grains; 16.51%), and the number 3 (6346 pollen grains; 16.14%). On the other hand, we also observed the taxa richness in honey samples: The number 2 contains pollen grains from 23 different taxa, the number 4 has 22 taxa and the number 5 has 21 taxa. When we examined the plant groups; it emerged that *Astragalus* spp. (14019 grains), Apiaceae (7050 grains) Brassicaceae (6379 grains)'dir. *Astragalus* spp, Apiaceae and Brassicaceae pollen grains are seconder, Fabaceae and Lamiaceae pollen grains are minor, pollen grains of the 18 taxa are in trace quantities. All of the samples are multifloral.

**Key words:** Ardahan province, Turkey, honeybees, melissopalynology, pollen analysis

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#### Ardahan ballarının polen analizi

#### Özet

Ardahan ilinin (Kuzeydoğu Anadolu) değişik lokalitelerinden on bal numunesinin içerdiği polenler incelenmiştir. Örnekler 13 aileden 23 farklı taksonun polen tanelerini içermektedir. En fazla polen içeriği 2 numaralı örnekte saptanmıştır (7890 polen tanesi; %20,07); 4 numaralı örnek (6480 polen tanesi; %16,51) ve 3 numaralı (6346 polen tanesi; %16,14) örnek bunu takip eder. Öte yandan bal numunelerinde takson sayısındaki zenginlik de gözlemlenmiştir: 2 numara 23 farklı takson, 4 numara 22 takson, 5 numara 21 taksondan polen numuneleri içermektedir. Bitki gruplarını incelediğimizde; *Astragalus* spp. (14019 tane), Apiaceae (7050 tane) Brassicaceae (6379 tane) 'dir. *Astragalus* spp, Apiaceae ve Brassicaceae polen taneleri sekonder, Fabaceae ve Lamiaceae polen minör seviyededir, 18 taksonun polen taneleri ise eser miktarda bulunur. Tüm numuneler çok-çiçeklidir.

**Anahtar kelimeler:** Ardahan ili, Türkiye, balırası, melissopalinojisi, polen analizi

#### 1. Introduction

Honey is known as a perfect food all around the world. Honey production starts with plant nectaries or insects from Hymenoptera. They both excrete sugar based secretions and honey bees collect these substances.

Geographic and botanical characteristics are significant for the quality of honey (Romas et al., 1999; Valencia et al., 2000). The taste, smell, and color of honey changes according to the nectar of the plant taxa. Melissopalynological analyses of honey expose the quality and the plant taxa of the honey's source (Lieux, 1972; Louveaux et al., 1978). Bees gather the nectar and pollen from flowers at the same time. The pollen that is mixed in the honey is essential for the honey's quality (Moar, 1985; Kaya et al., 2005).

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Turkey has a very high potential for beekeeping because of the rich plant diversity. It is useful to find which plants redound the honey production. These studies will allow finding the floristic regions that have potential for superior quality of honey (Sorkun, 1982).

The first pollen analysis in honey was made by Pfister in 1845 (Erdoğan et al. 2006). In different examples from different parts of Europe (Maurizio and Lauveouv, 1961, 1963), in Louisiana State of USA 54 (Lieux, 1972), Swiss 54 (Zürcher et al., 1975), New Zealand 119 (Moar, 1985), Alberta-Canada 36 (Feller-Demalsy et al., 1987), Canada-Saskatchewan 42 (Feller-Demalsy et al., 1987), Corsica-France 112 (Battesti and Goeury, 1992), Basque 115 (Sancho et al., 1991), Biala Podlaska-Poland 20 (Wroblewske, 1995), Greece 174 (Thrasylvouiou and Mahikis, 1995), Sardinia-Italy 150 (Floris et al., 1996), Galician-Spain 530 (Seijo et al., 1997), SE Chile 93 (Horn and Aira, 1997), La Palma-Canary Islands 25 (Romas et al., 1999), Spain 39 (Valencia et al., 2000), Croatia 8 (Sabo et al., 2011); were made melissopalynological analyses and emerged the flowering plants, which contributed honey production with their pollens and nectars.

The first melissopalynological study in Turkey was reported by Quistani in 1976. Many Turkish researchers followed Quistani (1976) and they studied on Turkish honey (Sorkun, 1982; Sorkun and İnceoğlu, 1984a, b, c; Sorkun ve Yuluğ, 1985a, b; Sorkun and Yuluğ, 1986; Sorkun et al., 1989; Gemici, 1991; Sorkun and Doğan, 1995a, b, 1999; Doğan and Sorkun 2001; Gür et al., 2001; Kaya et al., 2005; Erdoğan et al., 2006; Bağcı et al., 2006; Silici and Gökçeoğlu, 2007; Baba, 2007; Taşkın and İnce, 2009; Çam et al., 2010, Bakoğlu et al., 2014).

We studied Ardahan province of Turkey. There is a limited research on pollen analysis in Ardahan region (Sorkun et al., 2014). Researchers collected from six towns (Merkez, Çıldır, Posof, Damal, Hanak, and Göl) of Ardahan between the years 2010 and 2011. They reported that at the end of the microscopic analyses, pollen belonging to 16 plant taxa of 27 different plant families were identified from the Ardahan region. In this study, we collected from eleven different localities of Ardahan.

Ardahan is located in Eastern Anatolia that has 1800 m height. There is Georgia in the North, Georgia and Armenia in the East, Kars and Erzurum in the South and Artvin in the West of Ardahan. As the city has continental climate, winter is long, hard and snowy and summer is short and cool (Uzun and Müderrisoğlu, 2011).

Step vegetation is dominant in Ardahan province. One can divide the vegetation 2 prominent parts according to altitude. The representatives of the altitude between 1800-2000 m are *Alyssum linifolium* Steph. Ex Willd. subsp. *linifolium*, *Anemone narcissiflora* L. subsp. *narcissiflora*, *Artemisia absinthium* L., *Bromus tectorum* L. subsp. *tectorum*, *Centaurea rhizantha* C.A. Meyer, *Cirsium lappaceum* (Bieb.) Fischer subsp. *tenuilobium* (C.Koch) Davis et Parris, *Dianthus crinitus* SM. var. *crinitus*, *Festuca violaceae* Ser. ex Gaudin, *Helichrysum arenarium* (L.) Moench subsp. *rubicundum* (C.Koch) Davis et Kupicha, *Koeleria cristata* (L.) Pers., *Linaria grandiflora* Desf., *L. kurdica* Boiss. et Hohen subsp. *kurdica*, *Papaver orientale* L. var. *orientale*, *Poa bulbosa* L., *Sideritis montana* L. subsp. *montana*, *Stipa capillata* L., *S. lessingiana* Trin. et Rupr., *S. tirsia* Steven and *Thymus praecox* Opiz subsp. *caucasicus* (Ronniger) Jalas var. *grossheimii* (Ronniger) Jalas

The other important vegetation part is alpine grassland. In this region, the most common plants are: *Euphrasia lebardensis* Kem.-Nath., *Gentiana septemfida* Pallas, *Geranium palustre* L., *Pedicularis caucasica* Bieb., *Peucedanum longifolium* Waldst. Et Kit., *Phleum pratense* L., *Poa nemoralis* L., *P. trivialis* L., *Potentilla argaea* Boiss et Bal., *Sanguisorba officinalis*, *Trifolium nigrescens* Viv. subsp. *petrisavii* (Clem.) Holmboe, *T. repens* L. In more humid areas and by the rivers, there are *Alopecurus arundinaceus* Poir., *Carex acuta* L., *C. divisa* Hudson, *C. pachystylis* J. Gay, *Calamagrostis pseudophragmites* (Haller Fil.) Koeler, *Caltha polypetala* Hochst. Ex Lorent, *Ranunculus illyricus* L. subsp. *illyricus*, *Catabrosa aquatica* (L.) P. Beasuv., *Dactylorhiza osmanica* (KL.) Soo. *osmanica*, *Gentiana aquatica* L., *Juncus tenuis* Willd. and *Parnassia palustris* L. (Davis, 1965-1985; 1988; Güner et al., 2000; Altundağ, 2011).

*Salix caprea* L. and *S. caucasica* Andersson are dominant near the river banks. *Padus avium* Miller, *Prunus spinosa* L. subsp. *dasyphila* (Schur) Domin and *Spiraea hypericifolia* L. distributes in dried areas. The most common coniferous tree is *Pinus sylvestris* L. var. *hamata* meanwhile *Juniperus communis* var. *saxatilis* is a rare gymnosperm in this region.

## 2. Materials and methods

Eleven honey samples were obtained between May and July 2013 from honey dealers. The samples came from different localities and different altitudes between 1715-2461 m. (Figure. 1, Table 1). Honey samples (300 g) were collected from different locations was put into sterile jars. Samples were incubated at 65–70°C in water baths to prevent crystallization and stirred to get homogeneous suspensions. From these suspensions, 10 g samples (22, 23) were mixed with 20 mL distilled water, incubated at 45 °C in water bath and continuously shaken to dissolve honey in water. The mixture was centrifuged at 6000–6500 rpm, upper water phase was discarded and pre-prepared glycerol–gelatin mixture (1:1.5) was added to the tubes. They were transferred to a slide, covered with coverslip and prepared, then analyzed by using B-3000 model binocular microscope (equipped with 10x ocular and 10x, 40x, and 100x objectives) to determine and count the pollens. Various palynological resources (24-29) and nearly 800 different pollen preparations of the plants showing distribution at and around the sampling provinces were used in the determination of pollen contents. The terms

used for the frequency classes were: predominant pollen (more than 45% of the pollen grains counted), secondary pollen (16%-45%), important minor pollen (3%- 15%), and minor pollen (less than 3%) (30).

### 3. Results

We analysed 11 different honey samples which are collected from different stations in Ardahan. 23 taxa, which belong to 11 plant families, were found and detected in the samples (Table 2).

Honey specimen No.1 is obtained from Akkaya village, 1810 m (Figure 1). The vegetation in the area comprises meadows and pastures. The honey consists of pollens of 19 different taxa. It has Brassicaceae in seconder ratio (S), Apiaceae (346 pollen grains – 25.86%) and Asteraceae (152 pollen grains – 11.36%) with a minor ratio (M). The essential pollen ratios are *Echium* spp. (10 pollen grains – 0.75%), Scrophulariaceae (11 pollen grains -0.82%) and Liliaceae (12 pollen grains – 0.9%) taxa (Tablo 2).

Honey specimen No.2 is obtained from Tepeler village (2100 m). The vegetation in the area comprises meadows and pastures. The sample is the richest one in context of taxa number (23 taxa). *Astragalus* spp. pollen grains are close to half in the honey (39.54%) and in seconder level (S). The other remarkable taxa in minor level (M) are Apiaceae (14.63%) and Brassicaceae (12.78%). The essential ratio (E) taxa are *Geranium* spp. (0.10%), Caryophyllaceae (0.15%) Chenopodiaceae (0.22%).

Honey specimen No.3 is obtained from Tepesu village (1798 m). The vegetation in the area comprises meadows and pastures. We observed 20 different taxa in the honey. *Astragalus* spp are in seconder level (2144 pollen grains – 33.79%). Apiaceae (1875 pollen grains – 29.55%) and Brassicaceae (941 pollen grains – 14.83%) are in minor level. *Salvia* sp. (17 pollen grains – 0.27%), *Geranium* spp. (17 pollen grains – 0.27%), *Salix* spp. (25 pollen grains – 0.39%) are in essential level.

Honey specimen No.4 is obtained from Halil Efendi district (1816 m). The vegetation in the area comprises slopes, covered with meadows and pastures. *Astragalus* spp. (2686 pollen grains – 41.38%) and Apiaceae (1355 pollen grains – 20.88%) that represent the richest pollen contain are in seconder level. Brassicaceae (754 pollen grains – 11.62%) is in minor level and *Trifolium* spp. (10 pollen grains – 0.15%), Chenopodiaceae (11 pollen grains – 0.17%), Caryophyllaceae (14 pollen grains – 0.22%) are in essential level.

Honey specimen No.5 is obtained from Güneşgören village of Halil Efendi district (2461 m). Southern slopes of the village are covered with *Pinus* wood but the main vegetation is meadows and pastures. We observed 21 different taxa in the honey. The pollen rich taxa, in seconder level, are *Astragalus* spp. (2411 pollen grains – 38.02%) and Apiaceae (1420 pollen grains – 22.39%); and Brassicaceae (804 pollen grains – 12.68%) is in minor level. Taxa with low pollen grain amount are *Salix* spp. (11 pollen grains – 0.17%), Cyperaceae (18 pollen grains – 0.28%) and *Centaurea* spp. (18 pollen grains – 0.28%).

Honey specimen No.6 is obtained from Çimenkaya village of central district (2008 m). The vegetation in the area comprises meadows and pastures. We observed 20 different taxa in the honey. The richest families in context of pollen grains, in seconder level, are *Astragalus* spp. (252 pollen grains – 32.60%) and Lamiaceae (140 pollen grains – 18.11%). We observed Brassicaceae (92 pollen grains – 11.90%) in minor level. The pollen poor taxa are Caryophyllaceae (2 pollen grains – 0.26%), *Geranium* spp. (6 pollen grains – 0.78%) and *Centaurea* spp. (9 pollen grains – 1.16%).

Honey specimen No.7 is obtained from Aşıkzülali Köyü village of Posof district. The altitude of the village is 1715 m. The village is covered with anemophilous trees; *Quercus*, *Pinus*, *Picea*, *Caprinus*, *Corylus*. The vegetation also comprises meadows and pastures. We observed 20 different taxa in the honey. The richest families in context of pollen grains, in seconder level, are *Astragalus* spp. (427 pollen grains – 40.09%), Brassicaceae (218 pollen grains – 20.47%); and in minor level Fabaceae (87 pollen grains – 8.17%). The pollen poor taxa are *Hypericum* spp. (5 pollen grains – 0.47%), Scrophulariaceae (7 pollen grains – 0.66%) and *Trifolium* spp. (8 pollen grains – 0.75%).

Honey specimen No.8 is obtained from Uğurca Village (1908 m) of Posof district. Forest, meadow and pastures are main vegetation of the village. 17 taxa were determined in the honey. Highest pollen numbers, in order, *Astragalus* spp. (71 pollen grains – 17.23%) (seconder pollen), Fabaceae (63 pollen grains – 15.29%) (seconder pollen) and (52 pollen grains – 12.62%) (minor pollen). The pollen poor taxa are Chenopodiaceae (5 pollen grains – 1.21%), *Cirsium* spp. (5 pollen grains – 1.21%) and *Geranium* spp. (8 pollen grains – 1.94%).

Honey specimen No.9 is obtained from Göle district. The elevation of the district is 2020 m. Grassland and meadows cover the region. We observed 15 taxa in the honey sample. Highest pollen number in dominant level is *Astragalus* spp. (354 pollen grains – 47.64%), Fabaceae (93 pollen grains – 12.52%) and Lamiaceae (85 pollen grains – 11.44%) are in minor levels. The pollen poor taxa are *Geranium* spp. (2 pollen grains – 0.27%), *Echium* spp. (5 pollen grains – 0.67%) and *Centaurea* spp. (5 pollen grains – 0.67%).

Honey specimen No.10 is also obtained from Gole district. We observed 15 taxa in the honey sample. Highest pollen number in dominant level is *Astragalus* spp. (1781 pollen grains – 37.31%) (seconder pollen) Brassicaceae (1504- 31.50%) (seconder pollen) ve Apiaceae (714 pollen grains – 14.96%) (minor pollen). Pollen poor taxa are Chenopodiaceae (3 pollen grains – 0.06%), *Hypericum* spp. (5 pollen grains – 0.10%) and *Salvia* spp. (5 pollen grains – 0.67%).

Table 1. Samples of Ardahan honeys and their botanical origin

Sample No	Province – District	Village - District	Altitude (m)	Vegetation
1	Ardahan – Centre	Akyaka Village	1810	meadows and pastures
2	Ardahan – Centre	Tepeler Village	2100	meadows and pastures
3	Ardahan – Centre	Tepesuyu Village	1798	meadows and pastures
4	Ardahan – Centre	Halil Efendi district	1816	meadows and pastures
5	Ardahan – Hanak	Güneşgören Village	2461	<i>Pinus sylvestris</i> forest, meadows and pastures
6	Ardahan – Centre	Çimenkaya Village	2008	meadows and pastures
7	Ardahan – Posof	Aşıkzülali Village	1715	mixed forest, meadows and pastures
8	Ardahan – Posof	Uğurca Village	1908	mixed forest, meadows and pastures
9	Ardahan – Göle	Centre	2020	meadows and pastures
10	Ardahan – Göle	Centre	2020	meadows and pastures
11	Ardahan – Damal	Centre	2053	meadows and pastures

Honey specimen No.11 is collected from Damal district. The region is covered with meadows and pastures. This specimen has least pollen contain. We observed 14 taxa in honey. The highest pollen number taxa are *Astragalus* spp. (658 pollen grains – 30.63%) (sekonder polen), Brassicaceae (607 pollen grains – 28.26%) (sekonder polen) and Fabaceae (324 pollen grains – 15.08%) (seconder pollen). The poorest pollen taxa are Cyperaceae (11 pollen grains – 0.51%), Lamiaceae (12 pollen grains – 0.56%) and *Cirsium* spp. (15 pollen grains – 0.70%).

#### 4. Conclusions and discussion

The pollen contents of eleven samples of honey that are from different localities of the province Ardahan (Northeast Anatolia) are examined. The honey has the pollen grains of 23 different taxa from 13 families. The observed pollens are mostly in minor and trace levels. *Astragalus* spp. (37%), Apiaceae (18%) and Brassicaceae (17%) taxa are in the seconder level.

Step vegetation is dominant in studied area. This situation reflects its own vegetation characteristics. *Astragalus* spp. pollen grains are in mostly seconder level (S) (2-8, 10) and in dominant level (D) in one sample (9). The other taxa in seconder level are Brassicaceae, Fabaceae and Apiaceae. Several different taxa were also observed in minor and trace levels.

The pollen percentages vary in honey samples: 1 and 8 numbered samples minor (M), trace (E) and seconder (S); 2,4,5,6 and 7 trace (E), minor (M) and seconder (S); number 9 trace (E), minor (M) and dominant (D); number 11 trace (E), seconder (S) and minor (M) are listed in order. On the other hand in number 10 trace (E) pollens are abundant but seconder (S) and minor (M) pollens are equally.

The number of polen grains per 10 g of honey, PAC-10, extended from the “very poor” (<20.000) to the “very rich” category (500.000- 1000.000) (Feller-Demalsy et al., 1987). In this study, all honey samples are “very poor” in pollen grains (412-7890 pollen grains).

In Turkey, thanks to geographical and climatic conditions that provide a perfect environment for apiculture, honey production has been well developed. The pollen composition of the honeys revealed important information on the flora of the province.

An analysis were made in Kars *Acer platanoides* L., *Cotoneaster* spp., *Medicago sativa* L., *Prunus spinosa* L., *Prunus elaeagnifolia* (Spach) E. Murray ve *Tilia rubra* DC pollen grains are in seconder level (Sorkun and Yuluğ, 1986).

Sorkun and Yuluğ (1985) studied in Erzurum and they made a melissopalynological analysis. They observed that *Carum carvi* L., *Cistus* spp., *Cornus mas* L., *Diosyros lotus* L. taxa are dominant; *Carduus nutans* L., *Centaurea solstitialis* L., *Cotoneaster* spp., *Echium italicum* L. and *Epilobium angustifolium* (L.) Holub are in the seconder level.

Honey in Artvin province contains *Castanea sativa* Miller, *Cornus mas* L., *Daucus carota* L., *Diospyros lotus* L. and *Rubus canescens* DC in dominant level; *Acer campestre* L., *A. platanoides* L., *Arbutus andrachne* L., *Cirsium arvense* (L.) Scop., *Cotoneaster* spp., *Echium italicum* L., *Medicago sativa* L., *Pyracantha coccinea* M.Roem., *Tilia rubra* DC. subsp. *caucasica* (Rupr.) V. Engler, *Vicia sativa* L., *Xeranthemum annuum* L. in seconder level (Sorkun, 2007). The hony samples from Elazığ province contain *Peganum harmala* L. in dominant level and *Astragalus* spp., *Elaeagnus angustifolia* L. in the seconder level (Kaya et al., 2005).

Sorkun et al. (1989) studied 26 honey samples from Rize province and they observed as Fagaceae 72%, Fabaceae 27%, Ericaceae 16%, Rosaceae 8%, Tiliaceae 6%, Lamiaceae 5%.

The honeys of Bartın contain *Castanea sativa* Mill. in dominant level, *Rubus* spp. and *Rhododendron* spp. in seconder level (Kaya et al., 2005). In Kırklareli pollen grains of *Hedera helix* L. are in dominant and *Erica* spp. are in the seconder level. In Tekirdağ *Helianthus* spp. are dominant; *Solidago* spp. are in the seconder level (Kaya et al., 2005).

In Burdur province Taşkın ve İnce (2009) studied 20 honey samples. Dominant polens of this honey belong to Apiaceae, *Pimpinella anisum* L., *Anthriscus* spp., *Cardamine* spp., Compositae, *Centaurea* spp., Ericaceae and *Dianthus* spp. taxa, and the secondary polens belong to Brassicaceae, Fabaceae, *Crepis* spp., *Xeranthemum* spp. and *Trifolium* spp. taxa.

Silici and Gökçeoğlu (2007) studied 25 honey samples which are collected from Antalya province: Apiaceae, *Pimpinella anisum* L., *Raphanus raphanistrum* L., *Eucalyptus* spp., *Cirsium* spp., *Plantago* spp. and *Ulmus* spp. are in dominant level. Secondary pollen components observed from 11 taxa: *Anthemis* spp., *Astragalus* spp., *Citrus* spp., *Euphorbia* sp., *Ferula* spp., *Rosa* spp., *Rhamnus* spp., *Olea europaea* L., *Salix* spp., *Pimpinella anisum* L. and *Trifolium* spp.

Çam et al. (2010) observed 30 honey samples; The pollen grains of Fabaceae, Aceraceae, Boraginaceae, Poaceae, Asteraceae, Apiaceae, Caryophyllaceae, Rosaceae, *Hedysarum* spp., Brassicaceae, Fagaceae have been found to be the dominant and secondary group covers the *Plantago* spp., Cistaceae, Geraniaceae, Cucurbitaceae, Liliaceae, Caryophyllaceae, *Rumex* spp., Plantaginaceae, *Echium* spp., Campanulaceae, Salicaceae, Chenopodiaceae, Lamiaceae, Ericaceae pollen grains.

In Konya and Karaman provinces Bağcı and Tunç (2006) studied 21 honey samples, dominant polens were belong to Fabaceae, Asteraceae, Lamiaceae, Rosaceae, Apiaceae, Boraginaceae, Scrophulariaceae and Plantaginaceae families.

A study from İzmir province carried out pollen grains of *Castanea sativa* Mill., *Papaver* spp., Poaceae, *Vitex agnus-castus* L., *Cistus* spp., Ericaceae, Brassicaceae and Chenopodiaceae are dominant while Asteraceae, Fabaceae, *Rubus* spp., *Capparis ovata* Desf., *Tilia argentea* Desf. Ex DC. and *Eucalyptus camaldulensis* Dehnh. are in seconder level (Gemici, 1991). Honey from Marmaris district of Muğla province; *Lotus* spp., *Xanthium* spp. and *Erica* spp. are the seconder. *Centaurea* spp., *Carduus* spp., *Gosypium* spp., *Achillea* spp., *Salix* spp., *Helianthus* spp. are in the minor level (Kaya et al., 2005).

When we compared the melissopalynological studies made in Turkey, Ardahan honey has similiar content with honey from Inner Anatolia. Elazığ honey has also similar content with the observed specimens.

Turkey situates on intersection of three different floristic regions and it has a privileged position in terms of plant diversity (Davis, 1965-1988). Therefore, the pollen of different plants is found in honey samples in different geographical regions.

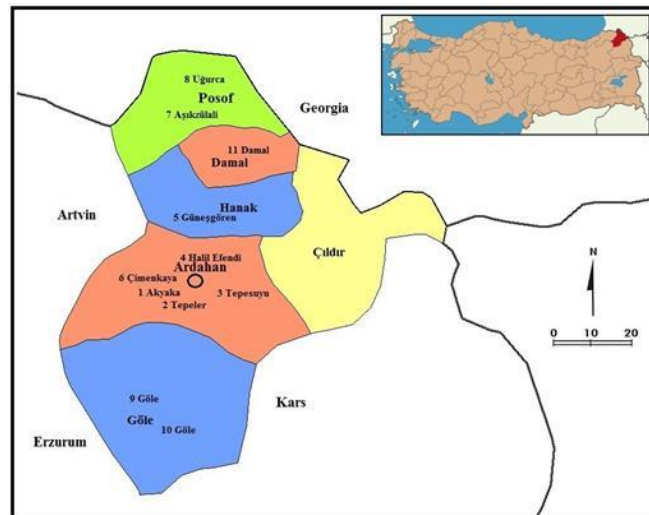


Figure 1. Ardahan province in northeast Turkey, where the analyzed honey samples were collected

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Table 2. Pollen counts and values of taxa detected presence of pollens in honey samples analyzed (Predominant pollen (more than 45% of the pollen grains counted), secondary pollen (16%-45%), important minor pollen (3%- 15%), and minor pollen (less than 3%) (30))

TAXA	SAMPLES NUMBER																								TOT AL										
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	7	8	9	10	11													
<i>Alyssum</i> spp.	20	1.49	E	54	0.68	E	28	0.44	E	20	0.31	E	13	0.20	E	14	1.81	E	18	1.69	E	28	6.80	M	28	3.77	M	7	0.15	E	14	0.65	E	261	
<i>Astragalus</i> spp.	115	8.59	M	312	39.5	S	214	33.7	S	268	41.3	S	241	38.0	S	25	32.6	S	427	40.0	S	71	17.2	S	35	47.6	D	178	37.3	S	658	30.6	S	1435	
Caryophyllaceae				12	0.15	E				14	0.22	E	20	0.32	E	2	0.26	E	11	1.03	E	8	1.94	E										71	
<i>Centaurea</i> spp.	20	1.49	E	148	1.88	E	45	0.71	E	28	0.43	E	18	0.28	E	9	1.16	E	27	2.54	E	12	2.91	E	5	0.67	E	34	0.71	E	16	0.74	E	375	
Chenopodiaceae				17	0.22	E				11	0.17	E							13	1.22	E	5	1.21	E				3	0.06	E				52	
<i>Cirsium</i> spp.	57	4.26	M	280	3.55	M	48	0.76	E	57	0.88	E	40	0.63	E	15	1.94	E				5	1.21	E				48	1.01	E	15	0.70	E	579	
Asteraceae	147	10.9	M	323	4.09	M	114	1.80	E	44	0.68	E	57	0.90	E	28	3.62	M	55	5.16	M	52	12.6	M	18	2.42	E	12	0.25	E	45	2.09	E	938	
Brassicaceae	346	25.8	S	100	12.7	M	941	14.8	M	754	11.6	M	804	12.6	M	92	11.9	M	218	20.4	S	21	5.10	M	84	11.3	M	150	31.5	S	607	28.2	S	6537	
Cyperaceae				21	0.27	E				14	0.22	E	18	0.28	E	20	2.59	E	34	3.19	M				9	1.21	E				11	0.51	E	135	
<i>Daucus carota</i>	61	4.56	M	78	0.99	E	51	0.80	E	48	0.74	E	57	0.90	E	11	1.42	E	9	0.85	E	10	2.43	E				45	0.94	E	57	2.65	E	441	
<i>Echium</i> spp.	10	0.75	E	141	1.79	E	153	2.41	E							18	2.33	E	12	1.13	E				5	0.67	E							348	
<i>Geranium</i> spp.				8	0.10	E	17	0.27	E	15	0.23	E	20	0.32	E				17	1.60	E	8	1.94	E	2	0.27	E							92	
<i>Hypericum</i> spp.	44	3.29	M	78	0.99	E	42	0.66	E	51	0.79	E	23	0.36	E	6	0.78	E	5	0.47	E	11	2.67	E	7	0.94	E	5	0.10					283	
Lamiaceae	45	3.36	M	218	2.76	E	112	1.76	E	541	8.33	M	651	10.2	M	14	18.1	S	54	5.07	M	46	11.1	M	85	11.4	M	65	1.36	E	12	0.56	E	2043	
Fabaceae	111	8.30	M	242	3.07	M	344	5.42	M	358	5.52	M	401	6.32	M	24	3.10	M	87	8.17	M	63	15.2	S	93	12.5	M	410	8.59	M	324	15.0	S	2533	
Liliaceae	12	0.90	E	35	0.44	E	26	0.41	E	57	0.88	E	27	0.43	E	11	1.42	E	8	0.75	E														181
<i>Origanum</i> spp.	63	4.71	M	84	1.06	E	71	1.12	E	51	0.79	E	57	0.90	E	32	4.14	M							21	2.83	E	12	0.25	E				407	
Rosaceae	54	4.04	M	443	5.61	M	92	1.45	E	101	1.56	E	210	3.31	M	18	2.33	E	21	1.97	E	21	5.10	M			30	0.63	E	22	1.02	E	1038		
<i>Salix</i> spp.	14	1.05	E	51	0.65	E	25	0.39	E	18	0.28	E	11	0.17	E		0.00		10	0.94	E				5	0.67	E	58	1.21	E	41	1.91	E	238	
<i>Salvia</i> spp.	21	1.57	E	29	0.37	E	17	0.27	E	54	0.83	E	35	0.55	E	21	2.72	E				15	3.64	M			8	0.17	E					210	
Scrophulariaceae	11	0.82	E	225	2.85	E	121	1.91	E	204	3.14	M	18	0.28	E	15	1.94	E	7	0.66	E			8	1.08	E	11	0.23	E					633	
<i>Trifolium</i> spp.	35	2.62	E	121	1.53	E	80	1.26	E	10	0.15	E	31	0.49	E	11	1.42	E	8	0.75	E	18	4.37	M			27	0.57	E	41	1.91	E		395	
Apiaceae	152	11.3	M	115	14.6	M	187	29.5	M	135	20.8	S	142	22.3	S	34	4.40	M	24	2.25	E	18	4.37	M	19	2.56	E	714	14.9	M	285	13.2	M	7177	
<b>TOTAL</b>	<b>133</b>			<b>789</b>			<b>634</b>			<b>649</b>			<b>634</b>			<b>77</b>			<b>106</b>			<b>41</b>			<b>74</b>			<b>477</b>			<b>214</b>			<b>3932</b>	

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