



POLLEN ANALYSIS OF HONEYS FROM THE ÇORUH VALLEY (TURKEY)

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ABSTRACT: Pollen analysis was carried out on 32 honey samples collected from Çoruh Valley of Turkey. A diverse spectrum of 69 pollen types from 33 botanical families was identified. All honey samples were classified as multifloral. Honeybee-favoured families included *Fabaceae*, *Lamiaceae*, *Caryophyllaceae*, *Asteraceae*, *Boraginaceae* and *Poaceae*. In the unifloral honeys, the predominant pollen types were *Achillea millefolium*, *Xanthium* sp., *Aster amellus*, *Glechoma hederacea*, *Teucrium* sp., *Ix patientia*, *Spergula arvensis*, *Rumex patientia*, *Sedum pallidum*, *Coronilla orientalis*, *Onobrychis viciifolia*, *Liliaceae* and *Ranunculus* sp.

Key Words: Melissopalynology; polen; bee plants; Çoruh Valley; Turkey

INTRODUCTION

There are four natural resources required by honeybees for survival: water, resin, nectar and pollen [1]. Nectar (a sweet liquid secreted by flowers of plants, consumed by bats, hummingbirds and insects and gathered by bees for making honey) is the main energy source for the colony. Pollen (the fine powdery material consisting of pollen grains that is produced by the anthers of seed plants) represents the colony's only supply of protein, essential for brood rearing and the glandular development of young worker bees [41, 18]. Honeybees visit various flowers of plant species, foraging for nectar and pollen grains. Honey bees play a very 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 [6, 25, 27]. Honey, as defined by the Codex Alimentarius (1989) is the natural sweet substance produced by honeybees from the nectar of blossoms or from the secretion of living parts of plants or excretions of plant-sucking insects living on parts of plants, which honey bees collect, transform and combine with specific substances of their own, store and leave in the honey comb to ripen and mature.

Exogenous pollen may be introduced into a beehive in numerous ways: bees carry pollen to the hive in their pollen baskets, pollen grains may fall from bees' body parts into the nectar filled combs, airborne pollen may enter the hive via air currents, used wax combs are added to hives, or imported pollen is fed to bees [30]. Honey is a complex mixture and presents very great variations in composition and characteristics due to its geographical and botanical origin [7, 8, 29]. Melissopalynology; a branch of palynology that deals with the analysis of bee pollen loads and the pollen grains in honeys. Melissopalynological analysis is still the effective method for botanical origin denomination and therefore it is one of the greatest discriminatory powers of honeys [30]. Pollen analysis 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 [39].

The earliest microscopic studies of honey were made by [28]; these suggested the possibility of determining the geographical origin of the honey from the pollen contained therein [20, 21, 24]. Studies to identify bee plants through melissopalynology have been carried out by several researchers in Turkey [34, 35, 36, 37, 17, 40, 13, 14, 19, 9, 33, 38, 16]. The aims of this research was to find out from the pollen spectrum of the honey sediment, the species of plant that take part in the production of the designated honey samples, as well as to predict with accurate logic the geographical origin of the honey samples in Çoruh Valley. I hope to continue this study to include all of the Turkish honeys.

MATERIALS AND METHODS

Description of the study sites

River Çoruh, originates at the Mescit Mountains (3,225 m) and flows 466 km before reaching the Black Sea within the national boundaries of Georgia.

The Çoruh Valley lies within the Caucasus ecological zone, which is considered by the World Wild Fund for Nature and by Conservation International as a biodiversity hotspot. The Çoruh Valley is recognised by Turkish conservation organisations as an important plant area [26], an important bird area [22], a key biodiversity area [15] and has been nominated as a high priority area for protection. The area is geographically diverse since the Çoruh Valley is surrounded with high mountains reaching to approximate 4000 m elevation (Kackar, 3932 m). The geology of the area is also very complex and diverse. The climate of the area is also quite various between humid-cold and dry hot. Such diversity of geology and climate provides very diverse habitats for flora and fauna. Therefore there are many plant species peculiar to this area. A study on the flora and the vegetation of the Coruh valley revealed that there are 518 plant species of which some are endemic to Turkey [3] (Figure 1-2).

Çoruh valley has favourable climate and vegetation for beekeeping in summer periods. There are thousands of hectares of citrus orchards *Salicaceae*, *Betulaceae* and *Pinaceae* forests as well as wild flowers such as *Asteraceae*, *Astragalus*, *Boraginaceae*, *Brassicaceae*, *Compositae*, *Salvia*, *Fabaceae*, *Lamiaceae*, *Lamiaceae*, *Onograceae*, *Thymus*, *Verbascum* and others. Most of the beekeepers are semi-professional and keep colonies for extra income. or hobbyists. A lot of honey bee Colonies are brought to the region by migratory beekeepers from different regions for honey production in the summer.



Figure 1. The regional location (circled) of the honey sample sites in Çoruh Valley.



Figure 2. Representative photos of the Çoruh Valley

Samples collection

Thirty honey samples were collected randomly from 32 regions of the Çoruh Valley (Table I). Honey samples were collected from beekeepers in the region where beekeeping activities exists. Regions plants were collected and stored in the herbarium at the Atatürk University.

Table I. Samples of Çoruh Valley honeys and their botanical origin.

Samples	Location		Altudute	Botanical Origin
S1	İspir county town	40°29'22.37"N- 41°00'30.83"E	1232	Blossom(Multifloral)
S2	Yedigöze	40°32'46.89"N- 41°03'03.31"E	1064	Blossom(Multifloral)
S3	Yedigöl	40°39'49.91"N- 40°58'39.75"E	1963	Blossom(Multifloral)
S4	Çatakkaya	40°39'54.92"N- 41°01'43.74"E	1707	Blossom(Multifloral)
S5	Çamlıkaya	40°38'37.77"N- 41°09'35.32"E	1160	Blossom(Multifloral)
S6	Sırakonaklar	40°43'09.72"N- 41°12'22.07"E	1318	Blossom(Multifloral)
S7	Geçitağzı	40°39'05.33"N- 41°17'40.39"E	1505	Blossom(Multifloral)
S8	Yavuzlar	40°37'14.88"N- 41°15'11.73"E	1826	Blossom(Multifloral)
S9	Değirmenli	40°30'00.68"N- 41°04'20.70"E	1426	Blossom(Multifloral)
S10	Düzköy	40°33'31.02"N- 41°00'10.56"E	1938	Blossom(Multifloral)
S11	Duruköy	40°29'58.26"N- 41°07'47.47"E	2018	Blossom(Multifloral)
S12	Başköy	40°36'24.71"N- 40°59'09.37"E	1784	Blossom(Multifloral)
S13	Kümetaş	40°27'09.49"N- 41°02'09.45"E	1769	Blossom(Multifloral)
S14	Moryayla	40°36'02.70"N- 40°56'04.77"E	2301	Blossom(Multifloral)
S15	Sandıklı	40°25'42.75"N- 41°04'13.25"E	1937	Blossom(Multifloral)
S16	Başpınar	40°24'57.13"N- 41°01'47.54"E	1963	Blossom(Multifloral)
S17	Akseki	40°17'17.11"N- 40°59'50.73"E	2288	Blossom(Multifloral)
S18	Kırık	40°17'44.98"N- 40°48'53.25"E	1922	Blossom(Multifloral)
S19	Cankurtaran	40°23'41.31"N- 41°00'31.13"E	2020	Blossom(Multifloral)
S20	İğdere	40°30'52.57"N- 40°51'02.57"E	1917	Blossom(Multifloral)
S21	Ayçukuru	40°18'59.94"N- 40°39'01.29"E	1985	Blossom(Multifloral)
S22	Laleli	40°23'57.10"N- 40°35'49.59"E	1395	Blossom(Multifloral)
S23	Arılı	40°22'20.35"N- 41°28'07.67"E	1613	Blossom(Multifloral)
S24	Kuşlu	40°31'35.43"N- 41°04'29.13"E	1511	Blossom(Multifloral)
S25	Adabaşı Köyü	40°22'38.36"N- 40°19'21.94"E	1480	Blossom(Multifloral)
S26	Köprüküyü	40°25'50.47"N- 40°58'16.74"E	1388	Blossom(Multifloral)
S27	Aydintepe	40°23'21.18"N- 40°09'01.88"E	1623	Blossom(Multifloral)
S28	Soğanlı	40°45'55.99"N- 40°15'04.98"E	469	Blossom(Multifloral)
S29	Irmakköy	40°29'11.01"N- 41°06'58.24"E	1950	Blossom(Multifloral)
S30	Büyükdere	40°32'42.77"N- 40°43'55.98"E	1940	Blossom(Multifloral)
S31	Alanbaşı	40°41'24.77"N- 41°24'41.55"E	1193	Blossom(Multifloral)
S32	Kılıçkaya	40°42'54.27"N- 41°28'50.65"E	1202	Blossom(Multifloral)

Analysis of pollen

Melissopalynological analyses were conducted methods recommended by the International Commission for bee botany [21] and the International Commission [41]. To determine frequency classes, >500 pollen grains were per sample [20]. Pollen types were classified into four categories. Predominant pollen (P, >45%), secondary pollen (S, 16 or 45%), important minor pollen (I, 3 or 15%) and minor pollen (M, <3%) [20]. When one pollen type represented >45% of the total number of pollen grains, the sample was classified as a monofloral honey [21]. The frequency occurrence of pollen, expressed as a percentage, was calculated by totaling the number of samples in which a taxon occurs and dividing by the total number of samples per melliferous area. To analyse the pollen content of the honey samples, two slides were prepared from each sample and photographed under a Euromex FE.2025 Trinocular light microscope. Pollen types were identified by comparison with reference slides of pollen collected directly from the plants in the study area and the used of microphotographs from the literature [1, 2, 24].

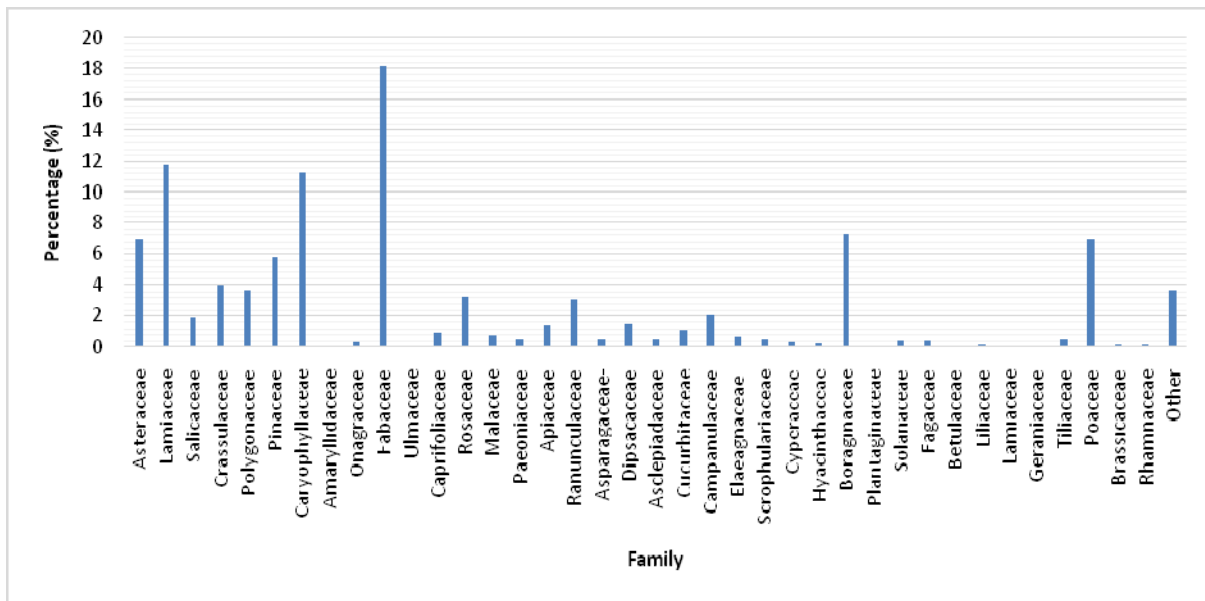


Figure 3. Frequency of occurrence of melliferous pollen types (> 30% frequency).

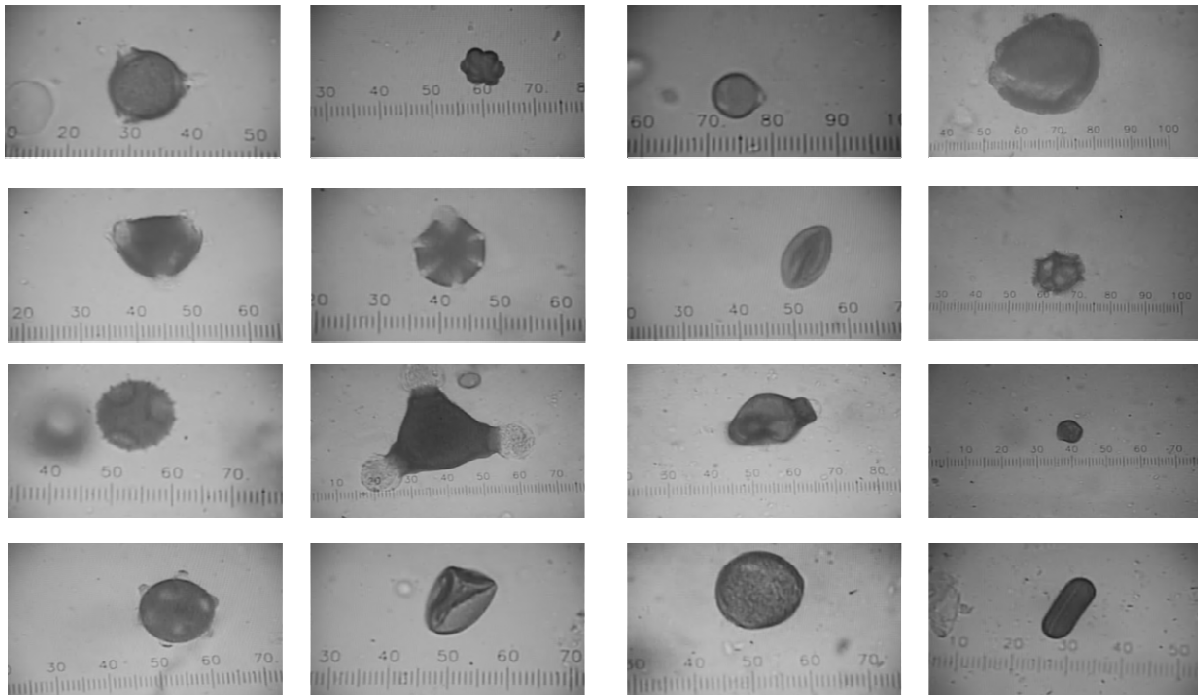


Figure 4. Some pollen types of Çoruh Valley honeys.

RESULTS

On the analysis of the samples taken from 32 different localities, it was found that Fabaceae pollen appeared in every one of the samples. The percentage of Asteraceae pollen found in twelve samples (S1, S2, S4, S9, S10, S11, S15, S21, S23, S24, S26, S30) was also the highest. The most widely represented families were Fabaceae (*Coronilla orientalis*, *Onobrychis viciifolia*, *Astragalus* sp., *Phaseolus* sp., *Crotalaria* sp., *Melilotus officinalis*, *Trifolium* sp., *Vicia sativa*), Lamiaceae (*Glechoma hederacea*, *Teucrium* sp., *Salvia* sp., *Lamium* sp.), Caryophyllaceae (*Spergula arvensis*), Boraginaceae (*Onosma asperrimum*, *Heliotropium europaeum*), Asteraceae (*Xanthium* sp., *Achillea millefolium*, *Tripleurospermum maritimum*, *Carduus pycnocephalus*, *Aster amellus*, *Sonchus oleraceus* L, *Cirsium vulgare*, *Cichorium intybus*, *Sonchus asper*, *Echinops* sp., *Centaurea* sp.), Pinaceae (*Juniperus* sp.). The highest percentage of pollen type found in this investigation was for *Cucurbita* sp. (S29). *Ulmaceae*, *Betulaceae*, *Liliaceae*, *Lamiaceae* and *Geraniaceae* were found in lower percentages. Pollen from *Ziziphus* sp. was found only in sample five (Table 2).

Pollens grains of 70 plant species belonging to 33 families were identified in 32 samples of honey from study area (Figure 1-2). The pollen analysis revealed that all of honey samples were multifloral (Figure 3). The pollen types identified were *Achillea millefolium*, *Xanthium* sp., *Aster amellus*, *Glechoma hederacea*, *Teucrium* sp., *Spergula arvensis*, *Rumex patientia*, *Sedum pallidum*, *Coronilla orientalis*, *Onobrychis viciifolia*, *Liliaceae*, *Ranunculus* sp., *poaceae* type plants are major source of forage for honeybees. *Fabaceae*, *Lamiaceae*, *Caryophyllaceae*, *Asteraceae*, *Boragaceae*, *Poaceae* are the best represented families in these honey samples (Table 1, Figure 4).

Table 2. Frequency classes for pollen types in selected honey samples from the Çoruh valley.

P= predominant pollen type (> 45%); S = secondary pollen type (16–45%); I = important minor pollen (3–15%); M = minor pollen (< 3%).

Sample No	Secondary Pollen (16-45 %)	Important minor Pollen (3-16%)	Minor Pollen (<3%)
S1	<i>Achillea millefolium</i> 19	<i>Cerasus avium</i> 4, <i>Crinum flaccidum</i> 6, <i>Glechoma hederacea</i> 11, <i>Juniperus</i> sp.10, <i>Onobrychis viciifolia</i> 10, <i>Ranunculus</i> sp.11, <i>Rumex patientia</i> 12, <i>Teucrium</i> sp. 6	<i>Astragalus</i> sp., <i>Crepis</i> sp. , <i>Epilobium angustifolium</i> , <i>Heracleum</i> sp. , <i>Liliaceae</i> , <i>Rosa canina</i> , <i>Salix</i> sp., <i>Verbascum</i> sp., <i>Xanthium strumarium</i>
S2	<i>Achillea millefolium</i> 23	<i>Crataegus monogyna</i> 3, <i>Glechoma hederacea</i> 7, <i>Juniperus</i> sp. 10, <i>Liliaceae</i> 6, <i>Onobrychis viciifolia</i> 9, <i>Paeonia officinalis</i> 6, <i>Poaceae</i> 4, <i>Ranunculus</i> sp 15, <i>Rumex patientia</i> 4, <i>Salix</i> sp. 8, <i>Sedum pallidum</i> 5, <i>Teucrium</i> sp. 5, <i>Xanthium strumarium</i> 8	<i>Aster amellus</i> , <i>Carduus pynoccephalus</i> , <i>Cerasus avium</i> , <i>Coronilla orientalis</i> , <i>Knautia arvensis</i> , <i>Potentilla reptans</i> , <i>Rosa canina</i>
S3		<i>Achillea millefolium</i> 13, <i>Crinum flaccidum</i> 5, <i>Glechoma hederacea</i> 11, <i>Juniperus</i> sp. 5, <i>Liliaceae</i> 7, <i>Onobrychis viciifolia</i> 10, <i>Ranunculus</i> sp. 5, <i>Rumex patientia</i> 6, <i>Teucrium</i> sp. 9, <i>Verbascum</i> sp. 12	<i>Carduus pynoccephalus</i> , <i>Centaurea</i> , <i>Cerasus avium</i> , <i>Chamerion angustifolium</i> L., <i>Coronilla orientalis</i> , <i>Crataegus monogyna</i> , <i>Crepis</i> sp., <i>Poaceae</i> , <i>Salix</i> sp., <i>Spergula arvensis</i> , <i>Tripleurospermum</i> sp., <i>Xanthium</i> sp.
S4	<i>Glechoma hederacea</i> 21	<i>Achillea millefolium</i> 9, <i>Onobrychis viciifolia</i> 5, <i>Poaceae</i> 4, <i>Ranunculus</i> sp. 5, <i>Rumex patientia</i> 4, <i>Salix</i> sp. 11, <i>Spergula arvensis</i> 5, <i>Teucrium</i> sp. 9, <i>Xanthium</i> sp. 5	<i>Astragalus</i> sp., <i>Celtis australis</i> L., <i>Cerasus avium</i> , <i>Coronilla orientalis</i> , <i>Crataegus monogyna</i> , <i>Crinum flaccidum</i> , <i>Epilobium angustifolium</i> , <i>Eryngium rostratum</i> , <i>Juniperus</i> sp., <i>Liliaceae</i> , <i>Lonicera infundibulum</i> , <i>Paeonia officinalis</i> , <i>Potentilla reptans</i> , <i>Sedum pallidum</i> , <i>Tripleurospermum</i> sp.
S5	<i>Aster amellus</i> 16	<i>Achillea millefolium</i> 4, <i>Campanula persicifolia</i> 7, <i>Carduus pynoccephalus</i> 12, <i>Glechoma hederacea</i> 3, <i>Juniperus</i> sp. 6, <i>Onobrychis viciifolia</i> 6, <i>Poaceae</i> 12, <i>Salix</i> sp. 11, <i>Spergula arvensis</i> 7, <i>Teucrium</i> sp. 6, <i>Xanthium</i> sp. 5	<i>Cerasus avium</i> , <i>Knautia arvensis</i> , <i>Liliaceae</i> , <i>Ranunculus</i> sp., <i>Ziziphus</i> sp.
S6	<i>Glechoma hederacea</i> 22	<i>Achillea millefolium</i> 10, <i>Coronilla orientalis</i> 11, <i>Juniperus</i> sp. 5, <i>Liliaceae</i> 14, <i>Onobrychis viciifolia</i> 5, <i>Poaceae</i> 3, <i>Ranunculus</i> sp. 10, <i>Rumex patientia</i> 3, <i>Spergula arvensis</i> 3, <i>Teucrium</i> sp. 3	<i>Aster amellus</i> , <i>Carduus pynoccephalus</i> , <i>Centaurea</i> sp., <i>Elaeagnus angustifolia</i> L., <i>Knautia arvensis</i> , <i>Phaseolus vulgaris</i> , <i>Sedum pallidum</i> , <i>Sonchus arvensis</i> , <i>Taraxacum officinale</i> , <i>Tripleurospermum</i> sp.
S7	<i>Liliaceae</i> 23	<i>Achillea millefolium</i> 6, <i>Coronilla orientalis</i> 6, <i>Glechoma hederacea</i> 3, <i>Juniperus</i> sp. 4, <i>Onobrychis viciifolia</i> 12, <i>Poaceae</i> 4, <i>Ranunculus</i> sp. 9, <i>Rumex patientia</i> 4, <i>Spergula arvensis</i> 5, <i>Teucrium</i> sp. 8, <i>Xanthium</i> sp. 6	<i>Crataegus monogyna</i> , <i>Crepis</i> sp., <i>Cucumis sativus</i> , <i>Eryngium rostratum</i> , <i>Lonicera infundibulum</i> , <i>Paeonia wittmanniana</i> , <i>Phaseolus vulgaris</i> , <i>Taraxacum officinale</i>
S8	<i>Onobrychis viciifolia</i> 19	<i>Achillea millefolium</i> 9, <i>Cerasus avium</i> 7, <i>Glechoma hederacea</i> 9, <i>Liliaceae</i> 11, <i>Poaceae</i> 14, <i>Ranunculus</i> sp. 6, <i>Salix</i> sp. 4, <i>Sedum pallidum</i> 4, <i>Teucrium</i> sp. 7	<i>Centaurea</i> sp., <i>Crataegus monogyna</i> , <i>Echinops</i> sp., <i>Juniperus</i> sp., <i>Phaseolus vulgaris</i> , <i>Pimpinella anisum</i> , <i>Rumex patientia</i> , <i>Xanthium</i> sp.
S9		<i>Achillea millefolium</i> 11, <i>Carduus pynoccephalus</i> 3, <i>Coronilla orientalis</i> 3, <i>Crataegus monogyna</i> 5, <i>Glechoma hederacea</i> 6, <i>Juniperus</i> sp. 6, <i>Liliaceae</i> 7, <i>Onobrychis viciifolia</i> 9, <i>Paeonia officinalis</i> 3, <i>Poaceae</i> 9, <i>Ranunculus</i> sp. 8, <i>Salix</i> sp. 6, <i>Spergula arvensis</i> 4, <i>Teucrium</i> sp. 3, <i>Xanthium</i> sp. 5	<i>Cyperus vegetus</i> , <i>Eryngium rostratum</i> , <i>Rumex patientia</i> , <i>Sedum pallidum</i> , <i>Taraxacum officinale</i> , <i>Tripleurospermum</i> sp.

S10	<i>Achillea millefolium</i> 24 <i>Spergula arvensis</i> 27	<i>Crataegus monogyna</i> 5, <i>Crinum flaccidum</i> 5, Poaceae 3, <i>Ranunculus</i> sp. 6, <i>Rumex patientia</i> 3, <i>Salix</i> sp. 3, <i>Teucrium</i> sp. 10, <i>Xanthium</i> sp. 3	<i>Cephalaria flava</i> , <i>Cerasus avium</i> , <i>Eryngium rostratum</i> , <i>Glechoma hederacea</i> , <i>Juniperus</i> sp., <i>Liliaceae</i> , <i>Onobrychis viciifolia</i> , <i>Verbascum</i> sp.
S11		<i>Achillea millefolium</i> 8, <i>Coronilla orientalis</i> 5, <i>Cynodon dactylon</i> 4, <i>Glechoma hederacea</i> 4, <i>Juniperus</i> sp. 6, <i>Liliaceae</i> 15, <i>Onobrychis viciifolia</i> 14, Poaceae 12, <i>Ranunculus</i> sp. 9, <i>Rumex patientia</i> 6, <i>Spergula arvensis</i> 5, <i>Teucrium</i> sp. 9, <i>Xanthium</i> sp. 8	<i>Celtis australis</i> L., <i>Cerasus avium</i> , <i>Crepis</i> sp., <i>Epilobium angustifolium</i> , <i>Eryngium rostratum</i> , <i>Paeonia officinalis</i> , <i>Phaseolus vulgaris</i> , <i>Tripleurospermum</i>
S12	<i>Rosa canina</i> 20	<i>Achillea millefolium</i> 14, <i>Aster amellus</i> 11, <i>Crepis</i> sp. 7, <i>Dandelion</i> 11, <i>Elaeagnus angustifolia</i> L. 5, <i>Epilobium angustifolium</i> 5, <i>Glechoma hederacea</i> 8, <i>Juniperus</i> sp. 13, <i>Onobrychis viciifolia</i> 12, <i>Ranunculus</i> sp. 13, <i>Rumex patientia</i> 13, <i>Sedum pallidum</i> 4, <i>Spergula arvensis</i> 4, <i>Teucrium</i> sp. 13	<i>Carduus pynoccephalus</i> , <i>Cephalaria flava</i> , <i>Coronilla orientalis</i> , <i>Crinum flaccidum</i> , <i>Liliaceae</i> , <i>Lonicera infundibulum</i> , <i>Onosma asperinum</i> , <i>Paeonia officinalis</i> , <i>Phaseolus vulgaris</i> , Poaceae, <i>Potentilla reptans</i> , <i>Rumex succudatus</i> , <i>Xanthium</i> sp.
S13	<i>Salvia</i> sp 27	<i>Achillea millefolium</i> 14, <i>Centaurea</i> sp. 11, <i>Cephalaria flava</i> 6 <i>Chamerion angustifolium</i> L. 3, <i>Cornus drummondii</i> 4, <i>Juniperus</i> sp. 7, <i>Lamium</i> sp. 9, Poaceae 11, <i>Quercus robur</i> 4, <i>Spergula arvensis</i> 4	<i>Nepeta petraea</i>
S14		<i>Aster amelu</i> 3, <i>Carduus pynoccephalus</i> 3, <i>Cerasus avium</i> 4, <i>Crinum flaccidum</i> 3, <i>Glechoma hederacea</i> 8, <i>Juniperus</i> sp. 5, <i>Onobrychis viciifolia</i> 6, <i>Phaseolus vulgaris</i> 3, Poaceae 3, <i>Ranunculus</i> sp. 5, <i>Rumex patientia</i> 7, <i>Salix</i> sp. 4, <i>Sedum pallidum</i> 4, <i>Spergula arvensis</i> 9, <i>Teucrium</i> sp. 7, <i>Tripleurospermum</i> sp. 3, <i>Xanthium</i> sp. 5	<i>Achillea millefolium</i> , <i>Berberis vulgaris</i> , <i>Lonicera infundibulum</i> , <i>Paeonia officinalis</i> , <i>Pimpinella anisum</i>
S15	<i>Achillea millefolium</i> 17	<i>Aster amellus</i> 4, <i>Centaurea</i> sp. 5, <i>Cerasus avium</i> 5, <i>Coronilla orientalis</i> 5, <i>Crataegus monogyna</i> 5, <i>Crinum flaccidum</i> 7, <i>Glechoma hederacea</i> 11, <i>Liliaceae</i> 5, <i>Onobrychis viciifolia</i> 9, Poaceae 11, <i>Ranunculus</i> sp. 7, <i>Rosa canina</i> 4, <i>Rumex patientia</i> 5, <i>Sedum pallidum</i> 6, <i>Teucrium</i> sp. 7, <i>Tilia</i> sp. 5, <i>Xanthium</i> sp. 6	<i>Carduus pynoccephalus</i> , <i>Eryngium rostratum</i> , <i>Salix</i> sp.
S16	<i>Juniperus</i> sp. 19 Poaceae 33	<i>Achillea millefolium</i> 10, <i>Cirsium vulgare</i> 4, <i>Cornus drummondii</i> 6, <i>Cornus mas</i> 6, <i>Onobrychis viciifolia</i> 4, <i>Rosa canina</i> 5, <i>Sedum pallidum</i> 4, <i>Teucrium</i> sp. 4	<i>Corylus avellana</i> , <i>Lamium</i> sp., <i>Salvia</i> sp., <i>Vicia sativa</i> ,
S17	<i>Onobrychis viciifolia</i> 30 Poaceae 26	<i>Achillea millefolium</i> 8, <i>Glechoma hederacea</i> 3, <i>Liliaceae</i> 3, <i>Ranunculus</i> sp 4, <i>Spergula arvensis</i> 5, <i>Teucrium</i> sp. 5, <i>Eryngium rostratum</i> 4	<i>Astragalus</i> sp., <i>Carpinus betulus</i> , <i>Centaurea</i> sp., <i>Cephalaria flava</i> , <i>Coronilla orientalis</i> , <i>Cucurbita</i> sp., <i>Datura</i> sp., <i>Elaeagnus angustifolia</i> L., <i>Epilobium angustifolium</i> , <i>Heracleum</i> sp., <i>Lamium</i> sp., <i>Lonicera infundibulum</i> , <i>Ornithogallum longibracteatum</i> , <i>Phaseolus vulgaris</i> , <i>Rumex patientia</i> , <i>Rumex succudatus</i> , <i>Salvia</i> sp, <i>Sedum pallidum</i> , <i>Xanthium</i> sp.
S18	<i>Onobrychis viciifolia</i> 24 Poaceae 26	<i>Achillea millefolium</i> 6, <i>Glechoma hederacea</i> 6, <i>Juniperus</i> sp. 7, <i>Liliaceae</i> 16, <i>Ranunculus</i> sp. 3, <i>Teucrium</i> sp. 4	<i>Aster amellus</i> , <i>Astragalus</i> , <i>Carduus pynoccephalus</i> , <i>Centaurea</i> sp., <i>Cornus drummondii</i> , <i>Crataegus monogyna</i> , <i>Eryngium rostratum</i> , <i>Melilotus officinalis</i> , <i>Phaseolus vulgaris</i> , <i>Plantago</i> sp., <i>Potentilla reptans</i> , <i>Sonchus asper</i> , <i>Spergula arvensis</i>
S19	<i>Juniperus</i> sp. 33 Poaceae 19	<i>Cornus</i> sp. 7, <i>Elaeagnus angustifolia</i> L. 8, <i>Knautia arvensis</i> 3, <i>Onobrychis viciifolia</i> 5, <i>Ornithogallum dubium</i> 6, <i>Paeonia officinalis</i> 4, <i>Salvia</i> sp. 3	<i>Cichorium</i> sp., <i>Cirsium vulgare</i> , <i>Crinum flaccidum</i> , <i>Teucrium</i> sp. <i>Achillea millefolium</i>

S20	<i>Spergula arvensis</i> 17	<i>Achillea millefolium</i> 4, <i>Achillea millefolium</i> 8, <i>Aster amellus</i> 12, <i>Cirsium vulgare</i> 7, <i>Cornus</i> sp. 15, <i>Lechoma hederacea</i> 6, Liliaceae 4, Poaceae 10, <i>Salvia</i> sp 6, <i>Sedum pallidum</i> 3	<i>Centaurea</i> sp. , <i>Cyperus vegetus</i> , <i>Elaeagnus angustifolia</i> L. , <i>Eryngium rostratum</i> , <i>Heliotropium europaeum</i> , <i>Ranunculus</i> sp. , <i>Teucrium</i> sp.
S21	<i>Achillea millefolium</i> 21	<i>Cerasus avium</i> 3, <i>Chamerion angustifolium</i> L. 6, <i>Cornus</i> sp. 12, <i>Heliotropium europaeum</i> 4, Liliaceae 12, <i>Lonicera infundibulum</i> 3, <i>Onobrychis viciifolia</i> 10, Poaceae 15, <i>Quercus robur</i> 8, <i>Rumex patientia</i> 3	<i>Datura</i> sp. , <i>Knautia arvensis</i>
S22	<i>Achillea millefolium</i> 21	<i>Coronilla orientalis</i> 3, Liliaceae 10, <i>Juniperus</i> sp. 9, <i>Onobrychis viciifolia</i> 7, <i>Paeonia officinalis</i> 3 , Poaceae 4, <i>Ranunculus</i> sp 14, <i>Rumex patientia</i> 5, <i>Sedum pallidum</i> 4, <i>Spergula arvensis</i> 4, <i>Teucrium</i> sp. 6, <i>Xanthium</i> sp. 4	<i>Aster amellus</i> , <i>Cerasus avium</i> , <i>Crataegus monogyna</i> , <i>Glechoma hederacea</i> , <i>Heracleum</i> sp. , <i>Potentilla reptans</i> , <i>Salix</i> sp.
S23		<i>Achillea millefolium</i> 13, <i>Glechoma hederacea</i> 4, <i>Juniperus</i> sp. 7, Liliaceae 4, <i>Onobrychis viciifolia</i> 8, <i>Phaseolus vulgaris</i> 5, Poaceae 11, <i>Potentilla reptans</i> 4, <i>Ranunculus</i> sp. 4, <i>Rumex patientia</i> 3, <i>Spergula arvensis</i> 18, <i>Teucrium</i> sp. 11	<i>Aster amellus</i> , <i>Carduus pynoccephalus</i> , <i>Chamerion angustifolium</i> L. , <i>Crataegus monogyna</i> , <i>Crepis</i> sp. , <i>Crotalaria</i> sp. , <i>Elaeagnus angustifolia</i> L. , <i>Epilobium angustifolium</i> , <i>Eryngium rostratum</i> , <i>Lonicera infundibulum</i> , <i>Paeonia officinalis</i> , <i>Salix</i> sp. , <i>Taraxacum officinale</i>
S24		<i>Achillea millefolium</i> 15, <i>Cerasus avium</i> 5, <i>Crepis</i> sp. 3, <i>Glechoma hederacea</i> 3, <i>Juniperus</i> sp. 4, Liliaceae 6, <i>Onobrychis viciifolia</i> 11, <i>Ranunculus</i> sp. 8, <i>Rumex patientia</i> 4, <i>Salix</i> sp. 6, <i>Teucrium</i> sp. 3, <i>Xanthium</i> sp. 5	<i>Apiacea</i> sp. , <i>Aster amellus</i> , <i>Cornus drummondii</i> , <i>Crataegus monogyna</i> , <i>Cyperus vegetus</i> , <i>Eryngium rostratum</i> , <i>Paeonia officinalis</i> , <i>Pimpinella anisum</i> , <i>Sedum pallidum</i> , <i>Taraxacum officinale</i>
S25	<i>Onobrychis viciifolia</i> 29	<i>Achillea millefolium</i> 10, <i>Lamium</i> sp. 5, Liliaceae 7, <i>Phaseolus vulgaris</i> 3, <i>Plantago</i> sp. 4, Poaceae 4, <i>Rumex acetosa</i> 13, <i>Rumex patientia</i> 6	<i>Aster amellus</i> , <i>Carduus pynoccephalus</i> , <i>Cirsium vulgare</i> , <i>Cornus</i> sp. , <i>Coronilla orientalis</i> , <i>Crataegus monogyna</i> , <i>Echinops</i> sp. , <i>Elaeagnus angustifolia</i> L. , <i>Eryngium rostratum</i> , <i>Lonicera infundibulum</i> , <i>Paeonia officinalis</i> , <i>Potentilla reptans</i> , <i>Salix</i> sp. , <i>Teucrium</i> sp. , <i>Tilia</i> sp. , <i>Trifolium repens</i> , <i>Tripleurospermum</i> sp.
S26	<i>Achillea millefolium</i> 17 <i>Coronilla orientalis</i> 21 <i>Onobrychis viciifolia</i> 19	<i>Phaseolus vulgaris</i> 4, Poaceae 4, <i>Ranunculus</i> sp. 5, <i>Rumex patientia</i> 10, <i>Teucrium</i> sp. 10	<i>Astragalus</i> sp. , <i>Carduus pynoccephalus</i> , <i>Celtis australis</i> L. , <i>Centaurea</i> sp. , <i>Cephalaria flava</i> , <i>Elaeagnus angustifolia</i> L. , <i>Glechoma hederacea</i> , <i>Juniperus</i> sp. , Liliaceae, <i>Melilotus officinalis</i> , <i>Paeonia officinalis</i> , <i>Rumex succudatus</i> , <i>Salix</i> sp. , <i>Sonchus asper</i> , <i>Tilia</i> sp. , <i>Xanthium</i> sp.
S27	<i>Aster amellus</i> 20	<i>Achillea millefolium</i> 13, <i>Cirsium vulgare</i> 3, <i>Crataegus monogyna</i> 3, <i>Elaeagnus angustifolia</i> L. 5, Liliaceae 6, <i>Onobrychis viciifolia</i> 5, <i>Paeonia officinalis</i> 8, <i>Phaseolus vulgaris</i> 3, <i>Salix</i> sp. 5, <i>Silene compacta</i> 5, <i>Spergula arvensis</i> 5	<i>Carduus pynoccephalus</i> , <i>Chamerion angustifolium</i> L. , <i>Cornus</i> sp. , <i>Datura</i> sp. , <i>Eryngium rostratum</i> , <i>Onosma asperrimum</i> , <i>Rubus fruticosus</i> , <i>Sedum pallidum</i> , <i>Teucrium</i> sp. , <i>Tilia</i> sp. , <i>Tripleurospermum</i> sp.
S28	<i>Xanthium</i> sp. 16	<i>Achillea millefolium</i> 7, <i>Glechoma hederacea</i> 4, <i>Juniperus</i> sp. 6, Liliaceae 3, <i>Onobrychis viciifolia</i> 13, Poaceae 6, <i>Ranunculus</i> sp 8, <i>Rumex patientia</i> 5, <i>Salix</i> sp 8, <i>Spergula arvensis</i> 14	<i>Aster amellus</i> , <i>Carduus pynoccephalus</i> , <i>Cephalaria flava</i> , <i>Chamerion angustifolium</i> L. , <i>Coronilla orientalis</i> , <i>Crataegus monogyna</i> , <i>Dandelion</i> , <i>Heliotropium europaeum</i> , <i>Heracleum terhaş</i> , <i>Phaseolus</i> sp. , <i>Rumex succudatus</i> , <i>Sedum pallidum</i> , <i>Tilia</i> sp. , <i>Tripleurospermum</i> sp.
S29	<i>Cucurbita</i> sp. 36	<i>Achillea millefolium</i> 15, <i>Cichorium</i> sp. 6, <i>Cornus</i> sp. 4, <i>Crataegus monogyna</i> 6, <i>Eryngium rostratum</i> 4, <i>Glechoma hederacea</i> 8, <i>Potentilla reptans</i> 4, <i>Ranunculus</i> sp 3	<i>Campanula persicifolia</i> , <i>Centaurea</i> sp. , <i>Teucrium</i> sp. , <i>Sedum pallidum</i> , <i>Coronilla orientalis</i> , <i>Crinum flaccidum</i> , <i>Datura</i> sp. , <i>Knautia arvensis</i> , <i>Onosma asperrimum</i> , <i>Phaseolus</i> sp. , <i>Rumex</i> sp. , <i>Tilia</i> sp.

S30	<i>Achillea millefolium</i> 16 <i>Spergula arvensis</i> 19	<i>Cerasus avium</i> 3, <i>Glechoma hederacea</i> 10, <i>Juniperus</i> sp. 9, <i>Onobrychis viciifolia</i> 3, <i>Ranunculus</i> sp. 10, <i>Rumex patientia</i> 12, <i>Teucrium</i> sp. 6, <i>Xanthium</i> sp. 5	<i>Crataegus monogyna</i> , <i>Crinum flaccidum</i> , <i>Eryngium rostratum</i> , <i>Heracleum</i> sp., <i>Paeonia officinalis</i> , <i>Potentilla reptans</i> , <i>Salix</i> sp. , <i>Sedum pallidum</i> , <i>Tripleurospermum</i> sp.
S31	<i>Juniperus</i> sp. 30 <i>Achillea millefolium</i> 16	<i>Glechoma hederacea</i> 5, Liliaceae 6, <i>Onobrychis viciifolia</i> 11 , <i>Ranunculus</i> sp. 4, <i>Salix</i> sp. 7, <i>Xanthium</i> sp. 11	<i>Cerasus avium</i> , <i>Crataegus monogyna</i> , <i>Euphorbia amygdaloides</i> , Poaceae , <i>Teucrium</i> sp. , <i>Tripleurospermum</i> sp.
S32	Poaceae 25	<i>Lonicera infundibulum</i> 16, <i>Achillea millefolium</i> 13, <i>Geranium</i> sp. 2, <i>Onosma</i> sp. 3, <i>Potentilla reptans</i> 5, <i>Sedum pallidum</i> 2, <i>Cephalaria flava</i> 4, <i>Cornus mas</i> 7, <i>Quercus robur</i> 5, <i>Salvia</i> sp. 7, <i>Juniperus</i> sp. 4	<i>Sedum pallidum</i> , <i>Tilia</i> sp. , <i>Rumex patientia</i> , <i>Heliotropium europaeum</i> , <i>Onobrychis viciifolia</i> , <i>Lepidium oleraceum</i>

DISCUSSION

Pollen is very important for honeybee nutrition [10, 12]. Honeybees collect pollen grains from entomophilous and anemophilous plants to obtain protein for their survival and reproduction [43, 4]. The bees frequently collect a wide variety of pollen types, but they generally concentrate on a few species [11, 5]. The pollen composition of the honeys studied revealed important information on the flora of the region. This report is the first melissopalynological study about honey from Çoruh Valley. The 32 honey samples are multiflora, each containing more than one pollen type. 70 plant species were identified in the 32 honey samples. In each sample, *Asteraceae*, *Fabaceae* and *Poaceae* are mostly represented indicating that the bees frequently visit these families. These plant families play important role in honey production.

In this study, thirteen Secondary Pollen types (*Achillea millefolium*, *Glechoma hederacea*, *Aster amellus*, Liliaceae, *Onobrychis viciifolia*, *Spergula arvensis*, *Rosa canina*, *Salvia* sp, *Juniperus* sp., Poaceae, *Coronilla orientalis*, *Xanthium* sp., *Cucurbita* sp.) were recorded in thirty-two multifloral honeys.

Achillea millefolium pollen in nine samples, *Onobrychis viciifolia* and Poaceae pollen in five samples, *Juniperus* sp. pollen in three samples, *Glechoma hederacea*, *Aster amellus* and *Spergula arvensis* pollen in two samples were found and Liliaceae, *Rosa canina*, *Salvia* sp, *Coronilla orientalis*, *Xanthium* sp. and *Cucurbita* sp. pollen in only one sample was found to be secondary.

The results proved that *Aster*, *onobrychis*, *rosa*, *salvia*, *juniperus* and *poaceae* are the secondary pollen. These plants were identified as important minor and minor pollen in Mediterranean region honey by Silici and Gökceoglu [33].

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