

## DANDELION HONEY: A NEW MONOFLORAL HONEY RECORD FOR TURKEY

*Karahindiba Balı: Türkiye Monofloral balları İçin Yeni Bir Kayıt*

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### ABSTRACT

*Taraxacum* species are important food source for many insects because of their early flowering and rich supply of nectar and pollen. *Taraxacum* (dandelion) honey has been characterized and specially produced in Europe. Although, Turkey, Iran, Afghanistan and the West Himalayas have the highest species richness and character diversities of *Taraxacum*, there are still gaps about the dandelion honey. The aim of the study was to evaluate the composition of dandelion honey which was a new record for the monofloral honeys originated from Turkey.

**Key words:** *Taraxacum*, Dandelion, Honey, Turkey

### ÖZ

*Taraxacum* türleri erken çiçeklenme dönemleri sebebiyle pek çok böcek için önemli bir polen ve nektar kaynağıdır. *Taraxacum* (karahindiba) balı Avrupa'da üretilmekte olan ve karakterizasyonu yapılmış bir baldır. Türkiye, İran, Afganistan ve Batı Himalayalar *Taraxacum*, tür zenginliği ve karakter çeşitliliği açısından en önemli bölgelerdir. Ancak bu bölgelerde karahindiba balı ile ilgili ciddi boşluklar bulunmaktadır. Bu çalışmanın amacı Türkiye monofloral balları açısından yeni bir kayıt olan karahindiba balının melissopalinojik ve kimyasal içeriğinin değerlendirilmesidir.

**Anahtar kelimeler:** *Taraxacum*, Dandelion, Bal, Türkiye

### GENİŞLETİLMİŞ ÖZET

*Taraxacum* türleri erken çiçeklenme dönemleri sebebiyle pek çok böcek için önemli bir polen ve nektar kaynağıdır. *Taraxacum* (karahindiba) balı Avrupa'da üretilmekte olan ve karakterizasyonu yapılmış bir baldır. Türkiye, İran, Afganistan ve Batı Himalayalar *Taraxacum*, tür zenginliği ve karakter çeşitliliği açısından en önemli bölgelerdir. Ancak bu bölgelerde karahindiba balı ile ilgili ciddi boşluklar bulunmaktadır. Bu çalışmanın amacı Türkiye monofloral balları açısından yeni bir kayıt olan karahindiba balı için melissopalinojik ve kimyasal içerik analizlerinin yapılmasıdır.

Karahindiba balı, Bingöl ili sınırları içerisinde arıcılık yapmakta olan arıcıların laboratuvarımıza analiz için gönderilen ballar içerisinde tespit edilmiştir. Dominant polen %96 oranı ile karahindiba kökenlidir. Kimyasal

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analizler: nem içeriği, GC-MS ile uçucu kimyasal bileşenlerin tespiti, HPLC ile glikoz ve früktoz şeker içeriklerinin tespiti, HPLC ile HMF içeriğinin tespiti ve UV-spektrofotometre ile fenolik içeriğinin saptanmasıdır.

Nem içeriği %14.9 olarak tespit edilmiştir. Karahindiba balının GC-MS ile yapılan uçucu bileşen analizine göre alkoller, aldehitler, yağ asitleri ve bunların esterleri, amino asitler, karboksilik asitler, aminler, aromatik amitler ve diğer kimyasal bileşikler ortaya çıkarılmıştır.

% 11.71 gliseraldehid ve% 8.62 benzamid, 2,4,6-trinitro-N, N-dimetil-bileşiği içerdiği gözlenmiştir. Gliseraldehit diğer bileşiklerle karşılaştırıldığında en yüksek oranda bulunur. "Butanal, 3 metil" oldukça yüksek bir oranda (%7.89) bulunmuştur.

Früktoz % 46.02, glüköz % 35.21 ve früktoz / glüköz oranı 1.3 olarak bulunmuştur. HMF değerini 1.73 ppm, toplam fenolik içeriği  $38.93 \pm 0.49$ mg GAE / 100g olarak bulunmuştur.

Ülkemizde üretilebilecek karahindiba balının karakterizasyonu için daha çok sayıda örnekle çalışılmalıdır. Bal üreticisi ve tüketicisi ile ekonomik açıdan da değerlendirmeler yapılarak, Türkiye'de üretilmekte olan monofloral ballara bir yenisinin eklenebileceği düşünülmektedir.

### INTRODUCTION

The genus *Taraxacum* is a member of the family Asteraceae, subfamily Cichorioideae, tribe Lactuceae and is found widely distributed in the warmer temperate zones of the Northern Hemisphere, inhabiting fields, roadsides and ruderal sites (Schütz et al., 2006). According to Richards (1973) the most ancestral forms of this genus are centered in the west and central Asia. The highest species and character diversities are found in Turkey, Iran, Afghanistan and the West Himalayas, but a similar richness is encountered also in north-central China and the southern Caucasus (Gurdal et al., 2017). In Turkey, the genus is represented by at least 62 taxa, 18 of them are endemic to the country (Gurdal et al., 2017).

Due to its early flowering and rich supply of nectar, *T. officinale* is an important food source for many insects, including butterflies, bee flies, hawk moths and bumblebees in Canada (Jackson, 1982; Stewart-Wade et al., 2002). More than 140 different non-specialist insect pollinators have been recorded on *Taraxacum* flowers. Besides pollen, the inflorescences provide nectar for pollinators. The single seeded fruits (achenes) are plumed with pappus and are effectively transported by wind (Van Dijk, 2007).

In Europe more than 100 botanical species are known to produce unifloral honey (Oddo et al., 2004). Most of them are produced occasionally or are only of local interest, whereas others are part of

the import-export market between different European countries (Oddo et al., 2004).

According to the International Honey Commission, *Taraxacum* pollen rarely exceeds 50% in *Taraxacum* labelled honeys, the contributions of other associated plants, such as from *Salix* or Brassicaceae, being in higher proportions (Oddo et al., 2004, Soria et al., 2008).

*Taraxacum* honey has been also characterized with melissopalynology, physicochemical and sensory characteristics (Oddo et al., 2004). Although Turkey, Iran, Afghanistan and the West Himalayas have the highest species richness and character diversities of *Taraxacum*, there is not any data about the dandelion honey originated from these regions.

The aim of our study is to evaluate a new unifloral honey record for Turkey: dandelion honey. It is the first time dandelion honey originated from Turkey is evaluated in a study.

### MATERIALS AND METHODS

#### Melissopalynological analysis

Honey sample was sent our laboratory from Bingöl province in the summer season of 2017. The sample was stored at  $22 \pm 2^\circ\text{C}$  until the time of analyses.

The materials were prepared for examination under the microscope according to the method of Louveaux et al. (1970) and Sorkun (2008).

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Observed pollen types were classified into three categories: dominant pollen ( $\geq 45\%$ , D), secondary pollen (16–44%, S), important minor pollen ( $>3\text{--}15\%$ , M) and rare pollen ( $3\%<$ ). When one pollen type represented  $>45\%$  of the total number of pollen grains, the sample was classified as a monofloral honey (Louveaux et al., 1978).

### Moisture

Portable refractometer was used to determine moisture content of honey (Bogdanov, 1997, Devillers et al., 2004).

### Gas chromatography-mass spectrometry (GC-MS) analysis

The Method for GC-MS was performed in accordance with Barcarola et al, (1998); Radovic et al.,(2001); Soria et al.,(2003); Cuevas-Glory et al.,(2007).

A GC 6890N from Agilent (Palo Alto, CA, USA) coupled with mass detector (MS5973, Hewlett-Packard) was used for the analysis of EEP samples. Experimental conditions of the GC-MS system were as follows: a DB 5MS column (30 m x 0.25 mm and 0.25  $\mu\text{m}$  of film thickness) was used and flow rate of mobile phase (He) was set at 0.7 mL/min. In the gas chromatography part, temperature was kept at 50°C for 1 min. After this period, the temperature was increased to 150°C with a 10°C/min heating ramp and then kept at 150°C for 2 min. Finally, temperature was increased to 280°C with a 20°C/min heating ramp and then kept at 280°C for 30 min. Chemical components were identified by using standard Willey and Nist Libraries available in the data acquisition system of GC-MS if the comparison scores were obtained higher than 90%.

### Sugar analysis by high-performance liquid chromatography (HPLC)

Sugar analyses (fructose and glucose) were performed according to the harmonized methods of the International Honey Commission (Bogdanov et al., 2002). In a 100-mL volumetric flask 5 g of honey was dissolved in 40 mL water. The honey solution was mixed with 25 mL of methanol. The flask was filled up to with water. The solution was poured through a 0.45  $\mu\text{m}$  membrane filter and collected in sample vials.

The analyses conducted by HPLC (Agilent Technologies 1200 Series, Germany) with a refractive index detector (HPLC-RID) using a carbohydrate column (Agilent Technologies Carbohydrate 5  $\mu\text{m}$ , 4,6 x 250 mm, USA).

### Determination of hydroxyl methyl furfural (HMF) by High Performance Liquid Chromatography (HPLC)

HMF content determined according to the harmonised methods of international honey commission's suggestions (Bogdanov et al., 2002). 10 g of honey was dissolved with 25 mL of water. The solution was diluted with 50 mL water and then filtered through a 0.45- $\mu\text{m}$  membrane filter. The samples analysed by HPLC (Agilent Technologies, USA) with UV detector (Agilent Technologies, USA) and C18-reversed phase column (Agilent Technologies, USA).

### Determination of total phenolic contents by UV

Total phenolic contents of samples were analysed by the Folin&Ciocalteu's phenol reagent (Folin C) colorimetric method described by Slinkard & Singleton (Slinkard and Singleton, 1977).

## RESULTS

### Plant taxa determined by melissopalynological analysis

As a result of the melissopalynological analysis, it was determined that *Taraxacum* spp. pollen was dominant with the ratio of 96%. The rare pollen composition of the honey was *Carduus* spp. (2.4%), Fabaceae (0.96%) and Euphorbiaceae (0.5%). The total number of pollen in honey was found as 7786.

### Moisture

The moisture content of dandelion honey was determined as 14.9%.

### Gas chromatography-mass spectrometry (GC-MS) analysis

GC-MS chemical compounds analysis of dandelion honey revealed alcohols, aldehydes, fatty acids and their esters, amino acids, carboxylic acids, amines, aromatic amides and other chemical compounds.

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**Table 1.** Chemical compositions of dandelion honey sample

**Tablo 1.** Karahindiba balının kimyasal kompozisyonu

Compounds	Taraxacum Honey
<b>Alcohols</b>	
Benzenemethanol, .alpha.-(1-aminoethyl)-, [R-(R*,S*)]- (CAS) NOREPHEDRINE	0,03
Ethanol, 2-bromo- (CAS) 2-Bromo	1,78
Ethanol, 2-bromo-(CAS) 2-Bromoethanol Ethylene bromohydrin	8,83
1,2-Ethandiol, diformate (CAS) ETHYLENE DIFORMATE Glycol diformate	0,23
<b>Aldehydes</b>	
Glyceraldehyde	11,71
Pentanal (CAS)	3,26
Butanal, 3-methyl-	7,89
<b>Fatty Acids and Their Esters</b>	
Octadecanoic acid (CAS)	0,08
<b>Amino acids</b>	
L-Alanine, ethyl ester	0,27
<b>Carboxylic acids</b>	
1-Piperazinecarboxylic acid (CAS) PIPERAZINE CARBONATE	1,14
Acetic acid, hydroxy[(1-oxo-2-propenyl)amino]-2-Acrylamidoglycolic acid	3,00
<b>Amines</b>	
1-Propanamine, N,2-dimethyl- Propylamine, N,2-dimethyl-	0,49
n-Hexylmethylamine N-n-Hexylmethylamine 1-Hexanamine, N-methyl	1,05
1-Pentanamine, N-methyl- Pentylamine, N-methyl- Methylamylamin	0,69
2-Butanamine, 3-methyl- (CAS) 2-Amino-3-methylbutane	0,10
1-Methyldodecylamine 2-Aminotridecane	0,56
<b>Aromatic amides</b>	
Benzamide, 2,4,6-trinitro-N,N-dimethyl-	8,62
1,2-Hydrazinedicarboxamide Biurea Hydrazodicarbonamide	0,69
Urea, N-methyl-N-nitroso- (CAS) N-Nitroso-N-methylurea NSC 23909	1,41
<b>Others</b>	
Piperazine (CAS) R22 Uvilon Antiren Pipersol Lumbrica	1,76
1,2,4-Triazine aS-Triazine	2,86
(tetrahydroxycyclopentadienone)tricarbonyliron(0)	4,35
4H,6H-Thieno[3,4-c]furan/	3,81
Propanenitrile, 3-(methylamino)-	0,06
2,4(1H,3H)-Pyrimidinedione, 5-nitro- 5-Nitrouracil	0,08

### Sugar analysis by high-performance liquid chromatography (HPLC)

Sugar content of dandelion honey was determined as fructose 46.02%; glucose 35.21%; fructose/glucose ratio 1.3.

### Determination of hydroxyl methyl furfural (HMF) by High Performance Liquid Chromatography (HPLC)

We found the HMF value as 1.73 ppm.

### Determination of total phenolic contents by UV

The total phenolic content of *Taraxacum* honey was found as  $38.93 \pm 0.49$  mg GAE/100g.

### DISCUSSION

Italian *Taraxacum* honey is characterized by low percentages (usually 5 to 15%) and a relatively high absolute pollen content, because of its almost constant contamination with *Salix* (which is over-represented) (Oddo et al., 1995). The dandelion honey originated from Turkey, 96 % of pollen composition classified as *Taraxacum* spp., classified as a monofloral honey.

Quick complete granulation with fine regular crystals; cream to yellow, sometimes with greyish hues color; intense, pungent, ammoniacal, persistent smell and flavor are the other features of Italian dandelion honey (Oddo et al., 1995).

Water content (%) were found  $16.9 \pm 0.9$  (n=23) (Oddo et al., 1995). According to our results, the moisture content of dandelion honey was determined as 14.9%. This difference can be originated from the harvest time or the weather conditions.

Throughout the ages, several health-promoting benefits, including diuretic, laxative, cholagogue, anti-rheumatic, antiinflammatory, choleric, anti-carcinogenic and hypoglycemic activities, have been attributed to the use of dandelion extracts or the plant itself (Schütz et al., 2006). GC-MS chemical compounds analysis of dandelion honey revealed alcohols, aldehydes, fatty acids and their esters, amino acids, carboxylic acids, amines, aromatic amides and other chemical compounds.

Soria et al. (2008) identified some kind of nitrile compounds in honey that is labelled as *Taraxacum* honey. Similar to their results we found a nitrile compound "Propanenitrile, 3-(methylamino)" in a ratio of 0.06% but also they mentioned that the nectar contribution of species belonging to the Brassicaceae family is proposed as the origin of the high relative amount of nitriles in *Taraxacum* honeys.

According to the volatile component analysis by GC-MS, we were observed that dandelion honey contains 11.71% glyceraldehyde and 8.62% benzamide, 2,4,6-trinitro-N,N-dimethyl- compound. Glyceraldehyde is found in the highest ratio compared to the other compounds. Owing to our

literature researches there is no data about this compound found in any kind of honey. Another compound "Butanal,3 methyl" is found with a quite high ratio (7.89%) compared to the other determined volatile compounds. It is also not found in the composition of any other honey samples before. These three compounds (Glyceraldehyde, benzamide, 2,4,6-trinitro-N,N-dimethyl-, Butanal,3 methyl) can be marker compounds for *Taraxacum* honey, but this data is insufficient to mention certain markers. Octadecanoic acid also called Stearic acid is one of the linear fatty acid esters and it is nature's most common long-chain fatty acids, derived from animal and vegetable fats. It is widely used as a lubricant and as an additive in industrial preparations. It is used in the manufacture of metallic stearates, pharmaceuticals, soaps, cosmetics, and food packaging (Özkök et al. 2016). This compound was found in low concentrations in the dandelion honey. So further researches are necessary to chemically characterize *Taraxacum* honey.

Sugar content of Italian dandelion honey were determined as fructose (%)  $38.8 \pm 1.9$ ; glucose (%)  $39.1 \pm 2.5$ ; fructose/glucose ratio  $0.99 \pm 0.05$ ; sucrose (%)  $1.2 \pm 1.5$  (n=14) (Oddo et al., 1995). We found fructose (%) 46.02; glucose (%) 35.21 and fructose/glucose ratio 1.3.

Both *Helianthus* and *Taraxacum* honeys have very high monosaccharide (particularly glucose) content, giving rise to a very high G/W and a very low F/G ratio. This is typical for honeys which granulate rapidly (Oddo et al., 1995).

The European Union (EU Directive 110/2001) established that the highest allowed amount of HMF in honey should be 40 ppm, with the exception of honeys of tropical origin (80 ppm). Our obtained results were all lower than legal limits with 1,73 ppm. and HMF (mg/kg)  $3.5 \pm 3.7$  (n=23) (Oddo et al., 1995).

Habati et al. (2017) found the total phenolic content of *Zizyphus lotus* honey as 38 mgGAE/100g. Sime et al., (2015) investigated the total phenolic contents of 10 multifloral honey samples and found the values between 330-610 mgGAE/100g. Rababah et al. (2012) investigated the 12 multifloral honey samples and found the total phenolic values between  $33.7 \pm 1.2$  and  $86.3 \pm 2.7$  mg GAE/100g. Krpan et al. (2009) researched 30 Acacia honey samples and found their total phenolic contents as 31.72 mg/kg to 80.11 mg/kg.

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Pontis et al (2014) analysed 10 honey samples from Roraima, Brazil and found the total phenolic contents of these honey samples between  $250 \pm 3.24$  and  $548 \pm 3$  mg/kg. al. found the Meda et al. (2005) found the total phenolic contents of bretaceae honey as  $52.08 \pm 0.31$  and  $59.67 \pm 1.35$  mg GAE/100g, Acacia honey as  $93.43 \pm 0.87$  mg GAE/100g, honeydew honey as  $113.05 \pm 1.3$  and  $114.75 \pm 1.30$  mg GAE/100g, Vitellaria honey as  $76.10 \pm 0.56$  and  $83.53 \pm 0.25$  mg GAE/100g. Our results show similarities with *Zizyphus lotus* honey and compared to the other honey types it has lower total phenolic content.

### CONCLUSION

Palynological and chemical compositions are the two important characters to classify the honey. Marketing of honey is only possible if these features have been evaluated. Honey is marketed specifying its botanical and geographical origin on the label, in order to guarantee authenticity and quality (Escriche et al., 2017).

Although *Taraxacum* honey is a new record for Turkey honeys, it has been characterized by International Honey Commission nearly three decades ago. Also dandelion honey is a very traditional honey type in Austria. In Turkey, *Taraxacum* species are really important source for beekeeping due to its early flowering and rich supply of nectar. But the beekeepers are not harvesting this kind of honey separately. Further investigations are necessary for the characterization of *Taraxacum* honey produced in Turkey. In our opinion, this value has to be evaluated by researchers and beekeeping industry.

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