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# The Quality Specialities in Turkiye's Honies for Apitherapy

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**Objectives:** In this study, the content of the honey produced by the flora of Turkey', physical, chemical and biological research aimed at active properties.
**Methods:** Searched the database EMBASE/Pubmed and Turkish Medicine Index research article about Turkiye honeys' specialities.
**Results:** Different botanical sources were caused, different kinds of chemical compositions of the honeys. The amount of HMF, pH, moisture, and acidity are the chemical qulity criteria of the honey. Carbohydrates are seem the most important components of honey. The glycemic index of the consumed honey is important. Turkiye's honey quality seems appropiate for using apitherapy.
**Conclusion:** Honey is the most important product of beekeeping all over the world in terms of economy and health. Manufacturers of honey should be careful while producing honey. They should be avoided unhealty situations and they should be obey the rules. These rules are the basis for protecting our health by consuming bee products.

**Keywords:** honey, Muğla, Turkey, apitherapy, bee, bee products

## INTRODUCTION

Honey is produced from the nectar of plants. It consists of 70-80% carbohydrates, it also contains a-tocopherol, ascorbic acid and other phenolics and enzymes such as glucose oxidase, catalase and peroxidase. These substances are also antioxidants [1]. It is a pure and functional food due to its high nutritional value [2]. The carbohydrate, especially glucose and fructose content of honey is important. 20 g honey per day meets 3% of the daily energy need. It also contains protein, amino acids, enzymes, minerals, trace elements, vitamins. This content has been the healing properties of honey throughout history. Antimicrobial, antiviral, antiparasitic, anti-inflammatory, antioxidant, antimutagenic and antitumor effects of honey are known [3]. With increasing demand for 'natural' honey and preference of therapeutic use for medicine and health, honey ingredients became important. Moreover, this unadulterated content of honey will also help increase market share and prevent unfair competition also [4]. Turkey is an appropriate geography for beekeeping. As of 2016, there were approximately 7 900 364 hives and 105727 tons of honey production [5]. 85% of the flower species in the world can be found in Turkish honey and their pollen content is rich [6]. So, we want to decide, Türkiye's honeys specialiates. And we want to see, all differences at a glance.

## MATERIALS AND METHODS

In this analysis, we performed a comprehensive search for a vailable literatures in electronic data bases of Pub Med, Embase Turkish Medicine Index research articles 1995 until August 16, 2017, about Turkiye honeys' specialities. Sixteen articles that content Turkiye's honey specialities were selected. This 16 studies, take some parts of Turkiye's region. Thus, this articles explain Turkiye's honey speciality part by part. Chemical, physical and microbiological properties show the quality of honey. The phenolic properties and carbohydrate contents of the honeys were compared. Ferric reducing/antioxidant power (FRAP), and free radical-scavenging activity of DPPH were were compared. Whole articles results take part into the table. The other

**Table 1.** Characteristics of the studies included in this analysis (2009-2017)

| | Akbulut [7] | Bağci (mg/kg) [8] | Gok [6] | Kambur [9] | Kılıç Altun (ppm) [10] | Kolayli [11] | Sari [12] | Sahin [13] | Özcan [14] | Yücel [15] | Yildiz [16] | Ozcan [17] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Muğla | Middleregions of Turkey | Differentgeographical regions of Turkey | Düzce | Southeastern of Türkiye | Black Searegion of Turkey | Edirne | Black sea | Konya | Hatay | Black Searegion | Central Anatolia, South-East Anatolia, Aegeanand Mediterranean Region |
| Sample | 15 | 43 | 144 | 10 | 81 | 23 | 50 | | 2 | 45 | 3 | 16 |
| Brix | 81.4-83.4 | | | | | | | | | | | |
| Water | | | | | | 17.4-19.05 | | | | | | |
| pH | 4.26-5.27 | | | | | 4.80-5.34 | 3.72-5.90 | | | | | 3.42-4.66 |
| Moisture (%) | 14.84-16.87 | | | 16.20-19.40 | | | 19.2-22.3 | | | | | 18.3-20.0 |
| Ash (%) | 0.24-0.60 | | | | | 1.30-1.52 | | | | | | 0.02-0.16 |
| Electrical conductivity (µS/cm) | 878-1,463 | | | 0.28-0.80 | | | | | | | | |
| Total acidity | | | | | | | 32.30-72.22 | | | | | 18.2-47.5 |
| Freeacidity (mEq/kg) | 6.23-15.62 | | | 21.0-70.0 | | | | | | | | |
| Proteins (µg/g) | 2,036-4,251 | | | | | | | | | | | 0.60-0.80 |
| Diastase activity (Gothe degrees) | 7.17-22.71 | | | 0.00-14.29 | | 17.45-19.20 | 17.90-38.50 | | | | | 10.9-17.9 |
| HMF (mg/kg) | 1.54-23.42 | | | 10.50-36.02 | | 1.05-5.40 | | | | | | 1.34-18.3 |
| Total reducing sugars (%) | 78.29-81.93 | | | | | | | | | | | |
| Reducing sugars (%) | 74.82-78.86 | | | | | | | | | | | |
| Sucrose (%) | 0.22-5.12 | | | 0.16-0.34 | | - | 0.48-3.42 | | | | | |
| Maltose (%) | | | | 0.80-1.39 | | 0.56-1.40 | | | | | | |
| Fructose (%) | | | | 30.27-32.73 | | 36.40-41.82 | | | | | | |
| Glucose (%) | | | | 23.13-26.97 | | 20.50-22.78 | | | | | | |

**Table 1.** Continued 1

| | Akbulut [7] | Bağci (mg/kg) [8] | Gok [6] | Kambur [9] | Kılıç Altun (ppm) [10] | Kolayli [11] | Sari [12] | Sahin [13] | Özcan [14] | Yücel [15] | Yildiz [16] | Ozcan [17] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trehalose | | | | | | 0.39-0.45 | | | | | | |
| Melibiose | | | | | | 0.42-1.4 | | | | | | |
| Melezitose | | | | | | Nd-1.44 | | | | | | |
| Fructose + Glucose (%) | | | | 53.67-59.61 | | | | | | | | 51.7-68.3 |
| Fructose/ Glucose | | | | 1.18-1.31 | | 1.60-1.90 | | | | | | |
| Refractive index | 1.4944- | | | | | | | | | | | |
| Density | 1.4044- | | | | | | | | | | | |
| Water activity (aw) | 0.479- | | | | | | | | | | | |
| Dynamic viscosity (Pa.sec) | 55.8- | | | | | | | | | | | |
| Colorpara-meters | L* | | | | | –1.79-2.40 | | | | | | |
| | a* | | | | | 7.52-24.36 | | | | | | |
| | b* | | | | | 12.20-28.46 | | | | | | |
| Molybdenum | 2.75-3.79 | | | | | | | | | | | |
| Aluminum | 27.09-121.05 | 6.659-27.07 | | | < 1-960 | | | | | 2.54-11.57 | | |
| Boron | 9.71-33.33 | 2.14-11.14 | | | | | | | 4.05 | 1.07-15.46 | | |
| Barium | | | | | | | | | | 0.05-0.68 | | |
| Calcium | 98.2-8,286.81 | 40.13-189.69 | | | < 1-4.5 | 320.24-463.10 | | | | 56-66-531.90 | | |
| Chromium | 0.50-0.72 | | | | < 1-< 1 | | | | 0.02 | 0.58-9.52 | | |
| Copper | 2.58-7.10 | | | | < 1-929 | 1.45-2.30 | | | 1.26 | | | |
| Cobalt | | | | | | | | | 1.17 | 0.01-0.12 | | |
| Iron | 165.0-411.8 | | | | < 1-7254.62 | 2.5-4.80 | | | 190.21 | 7.40-92.38 | | |
| Potassium | 1,064.48-4,737.31 | 161.01-1,598.55 | | | 1.18-268 | 25.24-51.25 | | | | 104.40-895.50 | | |
| Magnesium | 8.76-863.2 | | | | | 32.05-67.10 | | | | 13.55-132.40 | | |

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**Table 1.** Continued 2

| | Akbulut [7] | Bağci (mg/kg) [8] | Gok [6] | Kambur [9] | Kılıç Altun (ppm) [10] | Kolayli [11] | Sari [12] | Sahin [13] | Özcan [14] | Yücel [15] | Yildiz [16] | Ozcan [17] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Manganese | 9.65-13.66 | | | | < 1-274 | 4.36-5.846.29 | | | | 0.13-5.61 | | |
| Molibden | | | | | | | | | 1.50 | | | |
| Sodium | 320.7-621.1 | 9.34-45.90 | | | 0.48-13.1 | 28.30-52.00 | | | | 52.38-289.20 | | |
| Nickel | 36.9-58.08 | 0.00-0.17 | | | < 1-< 1 | | | | | 0.13-0.69 | | |
| Pb | | | | | | | | | | 0.06-2.02 | | |
| Phosphorus | 619.7-1,246.8 | 460.11-3,776.96 | | | | 56.20-71.02 | | | | | | |
| Zinc | 6.47-242.7 | 0.00-20.25 | | | < 1-237 | 1.38-1.45 | | | 112.76 | 1.02-30.67 | | |
| Silver | | 0.02-0.60 | | | | | | | | | | |
| Arsenic | | 0.00-2.11 | | | | | | | | | | |
| Barium | | 0.00-1.98 | | | | | | | | | | |
| Bismuth | | 0.00-6.70 | | | | | | | | | | |
| Indium | | 0.00-1.21 | | | | | | | | | | |
| Lithium | | 0.32-1.48 | | | | | | | | | | |
| Nickelium | | | | | | | | | 1.08 | | | |
| Selenium | | 0.00-2.39 | | | < 1-65.9 | | | | | | | |
| Strontium | | 0.00-0.55 | | | | | | | | 0.12-2.46 | | |
| Thallium | | 0.00-1.10 | | | | | | | | | | |
| Vanadium | | 0.00-0.09 | | | | | | | | | | |
| Cadmium | | | | | < 1-< 1 | | | | 0.39 | 0.01-0.12 | | |
| Predominantpollen (%) | | | | | | 0-92 | 0-72 | | | | | |
| Ureaseactivity | | | | | | | | 0.028-0.452 | | | | |
| FRAP | | | | | | | | 0.090-4.690 | | | 24.11 | |

**Table 1.** Continued 3

| | Akbulut [7] | Bağci (mg/kg) [8] | Gok [6] | Kambur [9] | Kılıç Altun (ppm) [10] | Kolayli [11] | Sari [12] | Sahin [13] | Özcan [14] | Yücel [15] | Yildiz [16] | Ozcan [17] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Radicals-cavenging-activity (DPPH) | | | | | | | | 10.892-411.416 | | | | 0.34-2.47 |
| Xantinoxi-daseac-tivity | | | | | | | | 0.028-0.452 | | | | |
| Phenolic-content-($mg_{gallicacid}$/100 g) | 234.9-394.0 | | | | | 19.07-101.67 | 6.896-23.201 | 9.400-65.300 | | | 0.98 | 400.73-645.85 |
| Total flavonoid | | | | | | 0.25-1.223 | | | | | | |
| Total tannin | | | | | | 0.001-16.67 | | | | | | |
| Antioxidan-activity | | | | | | 0.01-0.363 | 78.091-128.673 | | | | | 0.53-0.59 |
| Antiradi-calpower (DPPH, IC50) | 25.65-50.78 | | | | | | 24.647-65.437 | | | | | |

articles related to the therapeutic properties honey are not selected in this articles.

## RESULTS

Turkiye's honeys contents are shown in thet Table 1. Six different cities honey glycemic index are (Zonguldak, Kayseri, Mersin, Bursa, Muğla, and Aydın); Citrushoney 14.3-72.3; Thyme honey 17.1-85.0; Lime honey 20.7-84.5; Chestnut honey 26.1-89.4; Pine honey 30.1-103.4; Milk-vetch honey 25.2-109.0 [18].

## DISCUSSION

Honey's water content is the most important criterion of honey age and shelf life for evaluation [3]. Diastase number and HMF (Hydroxy methyl furfural) level are the quality criteria determinate of honey. And we see Turkiye's honeys' value suitable for consumption and health. Their quality appropriate for consumption. Carbohydrates are constitute the highly weighted part of honey [19]. In generally, about 80% of honey is made from different sugars (35% glucose, 40% fructose, 5% sucrose) and 17% water. There maining 3% consists of 180 different substances part contentmainly enzymes, amino acids, gluconicacid, phenol compounds, lactone, minerals and various vitamins [3]. The diversity of Turkey's flora make this concentration differentiates. In this content; Glycemic index (GI) could also take care. International Glycemic Index (GI) Tables indicate that honey has a value between 32 and 87, that is depending on the plant origin and depending on the amount of fructose [18]. Citrus and thyme honeys are in the low-GI group of honeys (< 55). In addition, chestnut honey appears to have the low glycemic index also. Serum insulin levels were found to be significantly lower than reference food consumptiont after two hours consumption of chestnut honey [18]. This situation is important, because at the end of the honey consumption high insulin level effect not strong than food consumption. Do this conclusion affect our view point of honey consumption? Could honey be used instead of sugar as a naturals weetener? Or, some carbonhydrate componets could be support with honey? Because, honey ingredients not only sugar but proteins, vitamins also enzymes same times, we thought. At the same time, honey is not

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identified as a protein source nutrient, but inside of the amino acids in the honey are also important for the origin of honey. Proline, lysine, phenylalanine, gamma-amino butyric acid (GABA), beta-alanine, arginine, glutamine, serine, glutamic acid, and aspartic acid can be given as examples of amino acids in the honey [3]. The antioxidants found in low amounts in honey depend on flower sources and nectar and are important for human body and health. In dark colored honey, antioxidant capacity was generally found high [17].

The mineral content and elements of honey can show us the geographical origin of honey. The presence of heavy metal, such as cadmium, iron, and lead, may indicate industrial contamination [8]. On the other hand, metal contents may indicate environmental pollution and the geographical mine origin. For example, some Zinc and iron contents may be due to the wires in the hives [15]. It seems that Turkiye's honey were found rich in calcium, potassium, sodium and phosphorus [8]. Honey samples biochemical properties collected from different geographical regions of Turkiye's (average mineral substance, moisture, acidity, HMF, number of diastases, invertsugar, pH, sucrose, electrical conductivity and heavy metal contents, trace elements and heavy metals content) are evaluated, the biochemical composition of all honey samples were determined by Turkish Food Codex standards generally [2]. Honey has been used in medicine to improve health throughout history. However, in the light of scientific data and many laboratoric research results, the use of honey and bee products has increased in recent years. And it has a place in medical literature as apitherapy. So, we could consumption Turkiye's flora honeys in confidently, we thought. I think the content is suitable and rich for their use in apitherapy.

But, detection adulterated honey is important. However, sometimes even the internal standard carbon isotope ratio analysis sometimes cannot detect honey's adulteration [19]. For this reason, we need to develop new methods for detect the adulterations for to provide humans health. Plants, flowers and geography form the characteristic of honey. The source of flowers and plants forms the chemical composition of honey and directly affects it [6]. There are over 100 different botanical origins suitable for honey making by the bees [7]. Our Anatolian soils content very wide plants variety [6]. Monofloral and polifloral honey specialities have, but beside of the wide flora, some of the fake (adulterated) honey was indentified. National and international laws and regulations with; Do not add any external material or one of the components do not be removed. Falsification by the addition of commercial glucose and starch reduces both the nutritional value of honey and the health of consumers [3].

## CONCLUSION

Using honey for health is only possible its proper production conditions. The chemical structure of honey depends on geographical and botanical diversity. A large part of its content consists of carbinohydrates. Antimicrobial and antioxidants are compounds that can improve human health. And, apitherapy is the use of bee products to prevent and/or treat of diseases and promote healing. It has been widely used in traditional medicine since ancient times, these uses are explained and recommended in religious books and epics.

## CONFLICT OF INTEREST

The author declare that there are no the conflict of interest.

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