

## Mineral Composition of Selected Honey From Turkey

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The aim of the present study was to determine the levels of some minerals, such as Na, K, Ca, Fe, Cu, Zn, Mn, Cr, Pb, in honey samples produced and consumed abundantly in Black sea region of Turkey. Three different floral and authentic honey samples, Anzer (n = 6), Bayburt (n = 8) and chestnut honeys (n = 15) were obtained from Black sea region of Turkey and analyzed by flame atomic absorption spectrophotometer (F-AAS). Both of the Anzer and Bayburt honeys are heterofloral and produced from a largest variety of mountain flowers in Anzer plateau near Iki-dere-Rize and Bayburt plateau, in the East-Black sea region of Turkey, respectively. Third group of monofloral botanical origin chestnut honey samples were supplied from Zonguldak in West Black sea region of Turkey. All samples were analyzed after nitric acid digestion. Nine minerals (Na, K, Ca, Fe, Cu, Zn, Mn, Cr, Pb) were quantified for each honey sample. Iron, copper, zinc, manganese, calcium, chromium and lead were determined by atomic absorption spectrophotometer and potassium, sodium by flame photometer. Na, K, Ca, Fe, Cu, Zn and Mn contents of minerals in honey samples were in the range of 28-41, 564-5007, 173-481, 3.2-6.7, 1.2-2.2, 1.2-17.2 and 1.2-17.2  $\mu\text{g g}^{-1}$ , respectively. However, Cr and Pb were below detection limit (0.01  $\mu\text{g g}^{-1}$ ) of the flame AAS. The amounts of K, Na and Ca were the most abundant elements in tested honey samples. Anzer honey samples were high in iron and chestnut samples were in manganese. The results showed that mineral contents in the studied 29 honey samples are highly variable and depend on their geographical and botanical origin.

**Key Words:** Anzer, Chestnut, Honey, F-AAS, Mineral.

### INTRODUCTION

Minerals play a vital role in proper development and health of the human body and several foods are considered to be the chief source of minerals needed in human diet. However, high amounts of elements are toxic for the most organisms<sup>1-3</sup>. Honey is a valuable natural product obtained by bees from several flower nectar or secretions from other living

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parts of plants and has been used since the ancient times<sup>4</sup>. Honey contains mainly simple sugars (80 %), glucose and fructose and 18 % of water content, 0.1-0.2 % minerals and the others proteins, flavonoids, phenolic compounds, organic acids and vitamins<sup>5,6</sup>. Honey's mineral content is depending on the particular botanical origin, climate, environmental conditions and the contribution of the beekeeper. Honey is a good indicator for the chemical constituents of the plants and their monitoring<sup>6-8</sup>. The mineral content in honey sample gives an indication of both environmental pollution and geographical origin<sup>7</sup>. In honeys, potassium is the major metal, followed the calcium and sodium and trace elements include iron, copper, zinc and manganese<sup>9-11</sup>.

Sweet chestnut (*Castania sativa* Mill.) is a multipurpose species that has been intensively cultivated as a monoculture around the Mediterranean and Central region of Europe<sup>12-14</sup>. Chestnut forest ecosystems still represent an important landscape component in the coast of the Black sea region of Turkey and chestnut based honeys are produced in these region. Total chestnut honey productions of Turkey are estimated 70,000 tons annually and the only chestnut honey production is 600 tons for the year of 2006 in Zonguldak region. The unifloral chestnut honey and propolis is darker than the other honeys, such as thyme, rhododendron, astragalus, sun flowers, citrus and various mountain flowers. Chestnut honey is believed to be a good ethno-remedy for asthma and respiratory diseases and protects from cancer<sup>14</sup>. The second honey sample, called Anzer honey, is the most famous honey type in Turkey and sold abroad, the most expensive and believed to have curative effects against many illnesses such as farangitis, tonsillitis, ulceration, heart and vascular diseases, infertility, cancer, anemia and in skin care. The second heterofloral honey samples belonging to the third group are collected from Bayburt plateaus and produced from flowers showing the largest variety in Turkey<sup>15,16</sup>.

Mineral contents of several Turkish honeys have been studied by different researchers<sup>2,17</sup>, but Anzer, Bayburt and chestnut honeys are not studied on the trace elements contents. The current study was designed to assess and compare mineral composition of chestnut, Anzer and Bayburt region honeys of Black sea region from Turkey, as well as to compare their nutritional potentials with each other.

## EXPERIMENTAL

**Honey samples:** 30 Honey samples from three different botanical regions of Turkey were studied. All honey samples were collected in May-July 2004. Honeys were thus classified into three groups (Table-1) according to the following botanical regions: Chestnut honeys (group I), Anzer honeys (group II) and Bayburt honeys (group III). Chestnut honey had the darkest colour followed by Bayburt and Anzer honeys.

TABLE-1  
METAL ION CONCENTRATIONS ( $\mu\text{g g}^{-1}$  or ppm)  
OF THE HONEY SAMPLES

Parameter	Chestnut Group I	Anzer Group II	Bayburt Group III
Iron	3.20 $\pm$ 1.90	6.70 $\pm$ 4.36	3.30 $\pm$ 1.60
Copper	0.43 $\pm$ 0.09	0.30 $\pm$ 0.05	0.27 $\pm$ 0.12
Manganese	17.20 $\pm$ 5.30	2.30 $\pm$ 1.16	1.20 $\pm$ 0.56
Zinc	2.20 $\pm$ 1.40	6.07 $\pm$ 2.70	1.20 $\pm$ 0.47
Sodium	28.00 $\pm$ 10.70	32.00 $\pm$ 10.60	41.00 $\pm$ 9.70
Potassium	5007.00 $\pm$ 1473.00	1125.00 $\pm$ 483.00	564.00 $\pm$ 160.00
Calcium	481.00 $\pm$ 168.00	173.00 $\pm$ 34.00	252.00 $\pm$ 158.00
Chromium	BD	BD	BD
Lead	BD	BD	BD

Data are means  $\pm$  SD of triplicate measurements.

BD, Below detection limit.

**Determination of mineral contents:** The samples were digested by wet oxidation method by treating the samples with  $\text{HNO}_3$  and  $\text{H}_2\text{O}_2$  and analyzed by using an ATI-Unicam 929 model atomic absorption spectrometer (Cambridge, U.K.) and Jenway PFP-7 flame photometer (England). The minerals were quantified against standard solutions of known mineral concentrations that were analyzed concurrently. The amounts of Na, K, Ca, Fe, Cu, Zn, Mn, Cr and Pb metal ions were evaluated at  $\mu\text{g g}^{-1}$  (ppm) level.

**Statistical analysis:** Analyses were carried out in triplicate and the mean  $\pm$  standard deviations are reported. Data are subjected to a 1-way analysis of variance (Kruskal-Wallis). P values  $< 0.05$  were regarded as significant.

## RESULTS AND DISCUSSION

The average mineral contents of honeys (mg/kg of honey) are shown in Table-1 and test statistics of 1-way analysis of variance (Kruskal-Wallis) of the honey samples are given in Table-2. In this study, total nine elements were quantified, namely iron, copper, zinc, manganese, sodium, potassium, calcium, chromium and lead. Recommended dietary allowance (RDA) values of these trace and major elements are 10-15, 1-3, 12-15, 2-5, 500, 2000, 1000 mg/daily, respectively<sup>14</sup>. Potassium was found almost five times higher in the chestnut honeys than the others. The highest and the lowest potassium concentrations were 5007  $\mu\text{g g}^{-1}$  in chestnut and 564  $\mu\text{g g}^{-1}$  in Bayburt honeys, respectively. Potassium, quantitatively, was found to be the most abundant and variable mineral in honeys by the several researches<sup>9,10,18,19</sup>. Great variability was found in potassium levels in the three different honeys and sodium values were found nearly stable ( $p < 0.05$ ). Sodium contents in present study were similar to those reported by some researches from Spanish and South-East Anatolia honeys<sup>6,11,20</sup>.

TABLE-2  
TEST STATISTICS OF 1-WAY ANALYSIS OF VARIANCE  
(KRUSKAL-WALLIS) OF THE HONEY SAMPLES

	Fe	Cu	Mn	Zn	Na	K	Ca
p value	0.045	0.010	0.000	0.002	0.083	0.000	0.002

p = values < 0.05 were regarded as significant.

The mineral concentrations of honeys were higher in chestnut honeys than the others. Manganese in chestnut honeys were present relatively high concentration. Some researchers have reported that chestnut honeys were richer in manganese than some honeys, such as wheat, peanut and eucalyptus<sup>19,21</sup>. In previous study, some minerals and chemical properties of chestnut, rhododendron and heterofloral flowers honeys and Mn, Ca and K concentrations were at the highest levels in chestnut honeys were investigated<sup>14</sup>. Therefore, high manganese levels may be as a marker of chestnut honeys and chestnut products for characterization. The amount of manganese, although it was higher when compared to that of other minerals and the recommended dietary allowance value, was quite below the toxicity level.

In the honey samples, copper values were found to be the lowest essential elements and there were statistical differences with each others (p < 0.05). Iron was the most abundant essential element present in Anzer honeys. Iron concentration was found two times higher in Anzer honeys than the others and the differences were significant (p < 0.05). The results of iron and zinc levels in the chestnut and Bayburt honeys were similar to those of Spanish honeys<sup>6,22</sup>.

Lead and chromium concentrations were also found below detection concentration of 0.01 µg g<sup>-1</sup>. This may be attributed that all of the honeys are not exposed to industrial pollution. It is worth nothing that the low levels of lead and chromium minerals show the low levels of contamination in the atmosphere and water in this area where the honeys are produced<sup>10,22</sup>.

In addition, we also found a linear correlation between the honey colours and mineral contents. The colour of honey is getting darker with increasing amount of minerals, but the slightly pale Anzer honeys are not coincides with these phenomena that slightly high iron and zinc concentrations. Some researches have reported that the mineral content and honey colour were linear in several honey types and the mineral content ranges from about 0.04 % in pale honeys and 0.2 % in some dark honeys<sup>23,24</sup>.

In conclusion, nine mineral contents were determined in order to evaluate the composition of three different types of Turkish honeys. Although the concentration of macroelements of K, Ca and Na were high in all the honeys, the amounts in chestnut honeys were higher than the others. The concentration of trace element iron was highest in the Anzer honeys. Especially,

the chestnut honeys were abundant in manganese that the highest manganese levels may also be used as a marker mineral for chestnut honeys or chestnut products. Honey could nutritionally be important as a good source of minerals and particularly chestnut honey is rich in potassium, manganese and calcium contents while the Anzer honey is rich in iron content.

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