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Determination of heavy metals in bee honey with connected and not connected metal wires using inductively coupled plasma atomic emission spectrometry (ICP–AES)

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Abstract Two honey samples are taken from two parts of the same honeycomb: one that contacts to the surface of the wire and the other taken from the surface that does not contact the wires. Heavy metal contents of these two samples were determined by inductively coupled plasma atomic emission spectrometry). The Mo, Cd, Cr, Fe, Mn, Ni and Zn contents of the honey in contact with wire is higher when compared to the other. Especially, Fe and Zn contents of honey in contact with wire is much higher than the non-contact one. These values are, respectively, 190.21 and 112.76 ppm. Besides, Ni content of honey in contact with wire is approximately 50% higher.

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Introduction

Honey is a sweet and viscous semi-liquid product produced by the honeybee, *Apis mellifera*, from nectar plants, modified and then stored in the comb for the later use as a nutritional food (Sato and Miyata 2000; Abu-Jdayil et al. 2002). The composition and properties of honey varies with floral sources utilized by the bees as well as regional and climatic conditions (Singh and Bath 1997). The honey of world commerce varies greatly in quality. Its quality is assessed largely on the basis of colour, odour and viscosity (Mendes et al. 1998). Honey is an excellent and widely used food that is popular all over the world (Demirezen and Aksoy 2005; Bağcı et al. 2007; Akbulut et al. 2009). Heavy metals have an important function for environmental pollution. Experiments carried out in Poland show that large amounts of heavy metals were found in urban crossroad and steelwork (Blunski et al. 1995). No studies were carried out on heavy metal contents of wire and not wire honey.

The aim of this work is to establish heavy metal contents of frame honey with a wire purchased in Market in Konya Province in Turkey.

Material and method

Honey samples (metal wire and not connect to the wire) used in this study were purchased from local markets. Honeycomb is pinned to the frame with a wire. The samples for analyses are taken from the regions that connect to this metal wire and do not connect to the wire. The samples are taken to the laboratory in clean glass jars.

About 0.5 g of each honey sample was put into burning cup with 15 ml of pure NHO_3. The sample was incinerated in a MARS 5 microwave oven (CEM Corporation Manufacturea in USA 3100 Smith Farm Road Matthews, NC) at 200°C. Distilled deionized water and ultrahigh-purity commercial acids were used to prepare all reagents, standards and honey samples. After digestion treatment, samples were filtrated through Whatman No 42 (Whatman 1442-055/28480-048, Maidstone, UK).

The filtrates were collected in 50-ml Erlenmeyer flasks and analysed by inductively coupled plasma atomic emission spectrometry (ICP–AES). The mineral contents of the honey samples were quantified against standard solutions of known concentrations which were analysed concurrently (Skujins 1998).

Working conditions of ICP-AES:

Instrument: ICP-AES (Varian-Vista)
RF Power: 0.7–1.5 kW (1.2–1.3 kW for Axial)
Plasma gas flow rate (Ar): 10.5–15 L/min (radial) 15 L/min (axial)
Auxiliary gas flow rate (Ar): 1.5 L/min
Viewing height: 5–12 mm
Copy and reading time: 1–5 s (max. 60 s)
Copy time: 3 s (max. 100 s)

Results of the research were analysed for statistical significance by analysis of variance (Püskülcü and Ikiz 1989). This research was performed by three replicates with a replicate.

Results and discussion

In the production of comb honey, the thin wires which allow the honey to attach to the comb are made of metal. Metal content of these materials may affect the composition of honey. Two honey samples are taken from two parts of the same honeycomb: one that contacts to the surface of the wire and the other taken from the surface that does not contact the wires. Heavy metal contents of these two samples are given in Table 1. The Mo, Cd, Cr, Fe, Mn, Ni and Zn content of the honey in contact with wire is higher when compared to the other. Especially, Fe and Zn contents of honey in contact with wire are much higher than the non-contact one. These values are, respectively, 190.21 and 112.76 ppm. Besides, Ni content of honey in contact with wire is approximately 50% higher. Cadmium is a heavy metal which is toxic and non-essential for human health. The most important sources of Cd pollution are metal industry and sewers. Higher cadmium concentrations cause defection of cardiovascular and skeleton systems due to acute toxicities (Demirezen and Aksoy 2005). When the excess of average levels for Ni is taken by foods, it can cause toxicity. The highest accumulation of nickel is in the lung and brain. Furthermore, it causes cancer in nasal cavity (Derrell 1991). The average recommended daily intake in foods is estimated to be 12–15 mg/day for zinc, 30 mg/day for Cu (WHO 1982; NRC 2000). Przybylowski and Wilenzynka (2001) reported that honey bees collected from different locations contain 0.008–0.027 mg/kg for Cd, 4.17–22.3 mg/kg for Zn and 0.025–0.071 mg/kg for Pb.

Table 1 Heavy metal contents of two different honeys ((ppm), $n = 3$)

Minerals	Contaminated honey	Non-contaminated honey
Co	1.17[a] ± 0.03[b]	1.22 ± 0.7
Mo	1.50 ± 0.1	1.23 ± 0.9
B	4.05 ± 0.12	4.16 ± 0.57
Cd	0.39 ± 0.01	0.25 ± 0.03
Cr	0.02 ± 0.0	0.0 ± 0.0
Cu	1.26 ± 0.3	3.43 ± 0.27
Fe	190.21 ± 0.27	44.98 ± 0
Mn	6.29 ± 0.23	5.45 ± 0.05
Ni	1.08 ± 0.17	0.48 ± 0.03
Zn	112.76 ± 3.7	12.69 ± 0.78

[a]Mean

[b]Standard deviation

The results show that the quality of the honeycomb framework to allow the honey to attach the metal wire is not in the desired quality. In addition, this situation shows that the wires used are not made of stainless steel which does not react with foods.

As a result, manufacturers of honey should be careful in buying similar materials, and they should purchase the ones which are in accordance with the standards. The materials that threaten human health should be avoided.

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Conflict of interest statement The author declares that there are no conflicts of interest.

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