Mineral content and physical properties of local and imported honeys in Saudi Arabia

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Abstract In addition to color, ash and electrical conductivity (EC), the levels of 14 minerals were investigated in 23 varieties of honey from Saudi Arabia and six other countries. The quantities of the macrominerals obtained were as follows (in ppm): K (298.60–491.40), Mg (80.70–199.30), Ca (60.75–99.95), P (21.10–33.29), and Na (15.69–26.93). The quantities of trace minerals were as follows (in ppm): Fe (67.18–98.13), I (12.61–94.68), Mn (4.15–6.04), Zn (3.44–5.72), Li (1.15–4.26), Co (1.00–1.32), and Ni (0.15–0.67). The quantities of the heavy metals Pb and Cd were found to be 0.06–0.23 and 0.00–0.16, respectively. The values of the tested elements—color, ash and EC—varied among the tested honeys according to their botanical origin. Dark honeys, especially acacia honeys, had higher elemental content and EC values than lighter ones. Saudi and Yemeni seder honeys exhibited no distinctive characteristics in their tested parameters. The levels of heavy metals indicated that the tested honeys were safe for human consumption.

1. Introduction

The demand for bio-products has been high in recent years. Bee honey, a bio-product consumed worldwide, is composed of sweet plant and bee secretions utilized and stored by honeybees in their hives as a source of energy. The major constituents of honey (~75%) are monosaccharides (fructose and glucose), with low quantities of disaccharides (sucrose) and polysaccharides. Minor constituents include enzymes, acids, minerals and unidentified substances. The composition of honey is influenced by some biotic and abiotic factors created around the bee colony, i.e., floral sources, climate conditions, soil, and beekeeper practices (White et al., 1962). Honey contains different quantities of minerals ranging from 0.02 g/100 g to 1.03 g/100 g, with potassium being the most abundant element comprising approximately one-third of the total mineral content (White, 1975; De Ferrer et al., 2004; Bogdanov...
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2. Materials and methods

2.1. Honey samples

Saudi samples were collected from local honey producers, whereas exotic samples were collected from local markets. Some exotic samples—manuka, tualang, Jarrah, and Egyptian honeys—were brought from New Zealand, Malaysia, Australia, and Egypt, respectively. The sampling and analysis procedures were as follows:

As shown in Table 1, native and exotic honeys (23 samples from seven countries) were tested. Thirteen honey samples were collected from different regions of Saudi Arabia (11 samples from native flowers and 2 from artificially fed colonies). Of the exotic samples, 3 were from Egypt, 2 from New Zealand, 2 from Germany, and 1 each from Yemen, Australia, and Malaysia. All tested honeys were produced by Apis mellifera except the Malaysian tualang honey, which was produced by Apis dorsata. The common names of these honeys, the year of their production and the regional data were also reported. All samples were packed in glass bottles (250 g/honey type) and maintained at room temperature (~25 °C) away from light prior to analysis.

3. Determination of minerals and physical properties

The following studies were conducted at the College of Food and Agriculture Sciences, King Saud University, Riyadh, Saudi Arabia, during June, 2010.

3.1. Minerals

Fourteen minerals (K, Mg, Ca, P, Na, Fe, I, Mn, Zn, Li, Co, Ni, Pb, and Cd) were determined in honey samples of known weight (3 replicates/honey type). An atomic absorption spectrophotometer (Model 3300, MS-DOS, detection limit is 3 s, µg/L, PerkinElmer Inc., USA) was used according to the method described by Chapman and Pratt (1961).

3.2. Optical density (OD)

One gram of honey was diluted with 9 ml of distilled water and centrifuged for 10 min at 3000 rpm. The absorbance of the filtrate supernatant was measured at 530 nm against distilled water as a blank using a computerized spectrophotometer (V-530 UV–VIS, JASCO Corporation, Japan).

3.3. Ash content

According to the AOAC methods (1990), 5-g of honey samples were placed in combustion pots, which required preheating to darkness with a gas flame to prevent honey foaming. Then, the samples were incinerated at high temperature (550 °C) in a burning muffle for 5 h. After cooling at room temperature, the obtained ash was weighed.

3.4. Electrical conductivity (EC)

The EC was calculated, depending on the ash content, according to the following equation reported by Piazza et al. (1991): EC (mS/cm) = 0.14 + 1.74 × A in which A is the ash content (g/100 g honey).

4. Statistical analysis

The collected data were statistically analyzed, and the mean values of three replicates per honey type were compared using the least significant difference (LSD) test at \( P < 0.05 \) probabil-