

## Honey as an environmental marker

Piotr Przybyłowski\*, Aleksandra Wilczyńska

*Merchant Maritime Academy, Department Of Comodity and Cargo Sciences, ul. Morska 83, 81-225 Gdynia, Poland*

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### Abstract

Contents of Zn, Cd and Pb in honey samples (15) from the Pomeranian region were determined by atomic absorption spectrometer AAS. The mean values for Zn, Cd and Pb were 7.76, 0.015 and 0.048 mg/kg, respectively. Also determined in the honey samples were invert sugar, sucrose, HMF, diastase activity, pH, electrical conductivity, moisture and mechanical pollutions. Pomeranian honeys were of good quality, but they were not free of heavy metals. Results suggested that honey may be useful for assessing the presence of environmental contaminants. © 2001 Elsevier Science Ltd. All rights reserved.

*Keywords:* Honey; Mineral content; Heavy metals; environmental marker

### 1. Introduction

Honey possesses valuable nourishing, healing and prophylactic properties. These properties result from its chemical composition. As a food stuff used for healing purposes, honey must be free of objectionable contents. It should contain only small amounts of pollutants, such as heavy metals.

There are few reports of environmental pollution by heavy metals. Experiments, carried out in Poland show big fluctuations in contents of particular heavy metals (Buliński, Wyszogrodzka-Koma, & Marzec, 1995; Dabrański, Roman, Górecká, & Kołacz, 1994). Few tested samples were free of them. Large amounts of heavy metals were found in honeys from hives located near extraurban crossroads and steelworks. More heavy metals were found in dark (honeydew) honeys. According to some Italian workers, honey may be viewed as an environmental marker (Leita, Muhlbachova, Cresco, Barbattini, & Mondini, 1996). They found large amounts of Zn, Cd and Pb in honeys. In particular, they found a linear relationship between amount of Cd in honey and that found in other biological markers, e.g. flowers of *Trifolium pratense*. Consequently, it is possible that contents of heavy metals in honey may be useful for assessing the presence of environmental contaminants.

### 2. Materials and methods

Natural honey samples (13 nectar and two honeydew honeys) from the Pomeranian region were provided by the local association of beekeepers. The 10-g samples of honey were incinerated in a microwave oven at 450°C and next dissolved in nitric acid. Concentrations of lead, cadmium and zinc were determined by atomic absorption spectrometry. Also, chemical compositions of these honey were determined. Invert sugar, sucrose, HMF, diastase activity, pH values, electric conductivity, moisture and insoluble matter were determined according to the polish standard for honey. The physicochemical parameters were determined using the methods of analysis summarized in Table 1.

### 3. Results and discussion

Mean mineral contents are shown in Table 2 and Figs. 1 and 2. The following average concentrations were determined: cadmium from 0.008 to 0.027 mg/kg; zinc from 4.17 to 22.3 mg/kg, and lead from 0.025 to 0.071 mg/kg. The mean values for Zn, Cd and Pb were 7.76, 0.015 and 0.048 mg/kg, respectively. Chemical compositions of investigated honey samples are shown

in Table 3. The chemical compositions generally fit the standards; however, the insoluble matter contents were much higher than the permissible limit for honey in Poland.

Few investigated samples were free of heavy metals. More cadmium was found in honeydew honey, and more lead in linden honey. The determined values were generally comparable to the values reported by other authors. It can be seen that pomeranian honeys generally have somewhat higher heavy metal contents than those reported from south-eastern Poland by Buliński et al. (1995) and lower than those reported from the West

Silesia region (Dobrzański et al., 1994). Some mineral contents exceeded acceptable limits, especially contents of Zn in floral and heather honey. In contrast to Pb and

Table 1  
Common physicochemical parameters determined — methods

Parameter	Method
Reducing sugars	Redox volumetry of Fehling reagent with methylene blue end point-detection
Sucrose	As above, acid hydrolysis and subtraction of reducing sugars value
Acidity	Titration with phenolphthalheine as indicator
Moisture	Refractometry at 20°C
HMF	Spectrophotometry at 550 nm
Diastase number	Goethe index
Electrical conductivity	Conductimetry of 200 g/l honey solution at 20°C
Insoluble matter	Gravimetry after 20–40 m sieve filtration

Table 2  
Concentrations of heavy metals in honeys (mg kg<sup>-1</sup>)

Honey	<i>n</i>	Zinc	Cadmium	Lead
Floral	2	22.3	0.015	0.070
Rape	4	4.17	0.008	0.034
Linden	1	4.33	0.010	0.071
Heather	2	18.2	0.022	0.053
Buckwheat	4	6.66	0.017	0.025
Honeydew	2	4.31	0.027	0.037
Mean	15	7.76	0.015	0.048
Acceptable limit (acc. to polish standard)	15			0.4

Table 3  
Chemical composition of the honey samples

Honey	<i>n</i>	Reducing sugars (%)	Sucrose (%)	Moisture (%)	Diastase number	Conductivity (10 <sup>-4</sup> S/cm)	HMF content (mg/100 g)	Insoluble matter	Acidity (ml 1 M NaOH/ 100 g)
Floral	2	73.4	1.23	17.7	8.3	2.0	0.58	0.66	1.75
Rape	4	77.14	1.36	17.7	8.3	1.4	0.63	0.53	1.45
Linden	1	72.4	1.68	18.0	17.9	4.5	0.68	0.84	1.85
Heather	2	70.5	1.36	20.3	8.3	2.6	0.36	0.91	1.3
Buckwheat	4	74.7	0.2	18.8	23.8	2.8	1.65	0.25	2.55
Honeydew	2	71.0	3.1	18.1	17.9	9.6	0.71	0.72	3.9
Polish legislation		> 70% N	<5%	<20%	> 8.3	> 2.10 <sup>-4</sup> S/cm	<3 mg/100 g	<0.1%	1–5 ml 1 M NaOH 100g

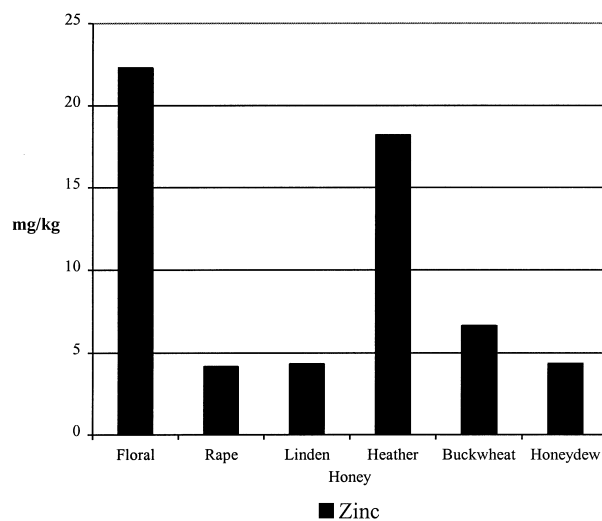


Fig. 1. Mean zinc content in honeys.

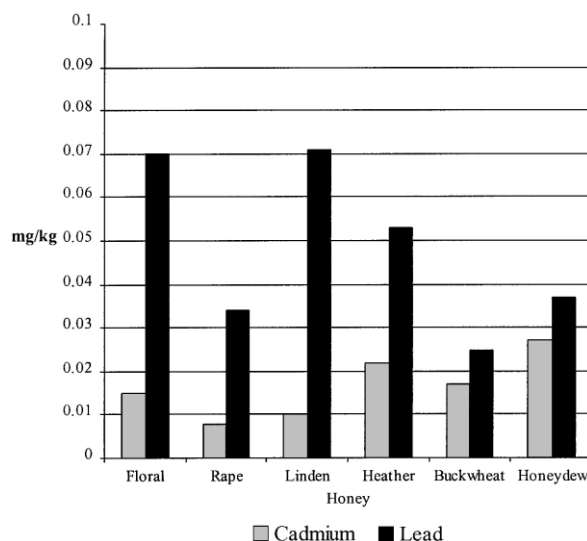


Fig. 2. Mean Cd and Pb content in honeys.

Cd, Zn is a micronutrient of biota, and is therefore unevenly present.

#### 4. Conclusions

1. All investigated honeys were good quality.
2. Analyzed honeys contained large quantities of zinc; floral and heather honey especially exceeded allowable concentrations.
3. Samples of honey contained insignificant amounts of lead and cadmium; it is appropriate to analyze concentrations of these metals in honeys to test contamination of the environment by heavy metals.

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