

Toxicological Assessment of Algerian Honey: Heavy Metal Contamination as an Indicator of Environmental and Public Health Risks

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INTRODUCTION & AIM

Honey is a nutritious natural product that also serves as an environmental indicator, reflecting botanical and ecological conditions. Bees can collect pollutants and trace metals that accumulate in honey, revealing environmental quality. While elements like Cu, Zn, and Fe are essential in small amounts, Cd and Pb are toxic even at low levels and can cause kidney and liver damage [1,2].

OBJECTIVE

- **Toxic Element Assessment:** To investigate the levels of trace elements (Cu, Fe, Zn, Cd, and Pb) in fourteen unifloral and multifloral honey samples sourced from Northern Algeria.
- **Health Risk Evaluation:** To assess the potential human health risks associated with the consumption of these honeys.
- **Environmental Monitoring:** To examine the utility of honey as a natural bio-monitoring tool for environmental surveillance.

METHOD

MATERIALS

❑ **Sample Collection:** Fourteen honey samples (coded MH1–MH14), comprising both unifloral and multifloral varieties, were collected during the 2022 harvest season.

❑ **Floral Sources:** The principal floral sources included: *Nasturtium officinale*, *Thymus ciliatus* subsp. *coloratus*, *Scolymus hispanicus*, *Eucalyptus globulus*, *Citrus sinensis*, *Euphorbia guyoniana*, *Ziziphus lotus*, *Petroselinum crispum*, *Daucus carota*, and *Rosmarinus officinalis*.

❑ **Storage and Preservation:** All samples were coded, transferred to sterilised glass containers, and stored at 4 °C until subsequent analysis.

❑ **Sample Digestion:** Accurately weighed honey portions (200–300 mg) were subjected to closed-vessel microwave digestion using spectrally pure HNO₃.

❑ **Trace Element Quantification:**

○ **Cd and Pb:** Measured by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) (PerkinElmer NexION 300D). Collision/Kinetic Energy Discrimination (KED) was applied to minimise polyatomic interferences.

○ **Fe:** Determined by Flame Atomic Absorption Spectrometry (FAAS) at 248.3 nm (Zeeman background correction).

○ **Cu and Zn:**

- **Cu:** Quantified by Electrothermal Atomic Absorption Spectrometry (ETAAS) at 324.8 nm.

- **Zn:** Quantified by Flame Atomic Absorption Spectrometry (FAAS) at 213.9 nm.

❑ **Method Validation:** Limits of Detection (LODs) were established using ten replicate blanks (3×SD).



Element	Technique	LOD (Concentration)
Cd	ICP-MS	0.017 µg/kg
Pb	ICP-MS	0.16 µg/kg
Fe	FAAS	0.19 mg/kg
Cu	ETAAS	0.53 µg/L
Zn	FAAS	0.013 mg/L



Figure 1. Algerian honey sample origins.

RESULTS & DISCUSSION

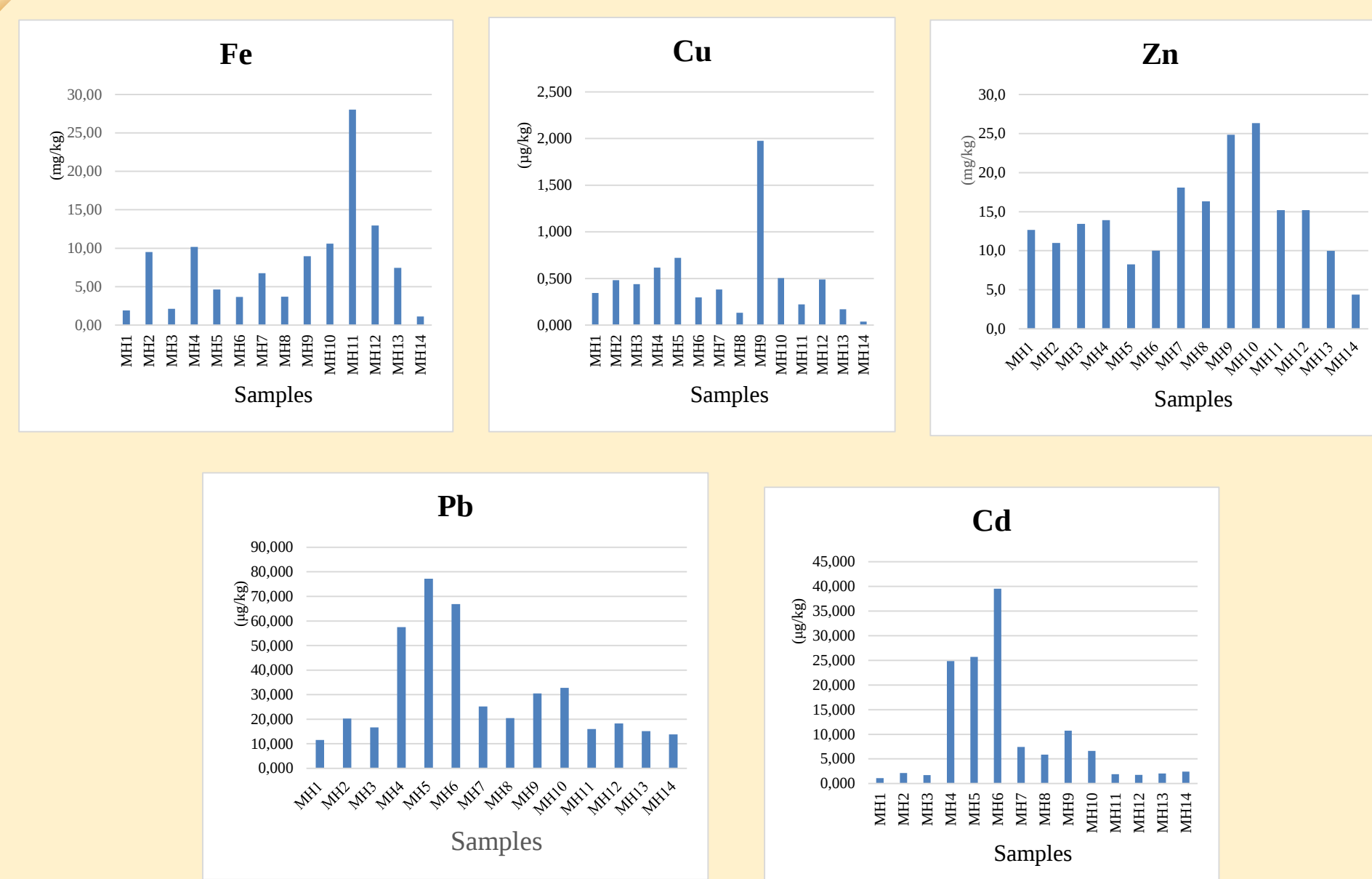


Figure 2. Trace Element Concentration Distribution in Honey.

- The figures show the distribution of heavy metals (Fe, Cu, Zn, Pb, and Cd) in the analyzed honey samples.
- The results indicate variability among samples, with Fe and Zn generally showing the highest concentrations, reflecting their essential biological roles.
- Cu levels are moderate, while Pb and Cd, which are toxic metals, appear in lower but significant amounts in some samples.
- These variations may reflect differences in environmental conditions, floral sources, and possible contamination from surrounding activities.

CONCLUSION

Analysis of Algerian honeys revealed significant variation in metal content based on origin. High concentrations of Fe and Zn highlight their nutritional value, whereas elevated levels of Pb and Cd in some samples pose a health risk and indicate environmental contamination, possibly from a common source. Therefore, regular monitoring is essential to guarantee consumer safety and support sustainable honey production practices.

FUTURE WORK / REFERENCES

1. Hung, K.-L.J.; Kingston, J.M.; Albrecht, M.; Holway, D.A.; Kohn, J.R. The worldwide importance of honey bees as pollinators in natural habitats. *Proc. R. Soc. B* **2018**, *285*, 20172140. doi:10.1098/rspb.2017.2140.

2. Burden, C.M.; Morgan, M.O.; Hladun, K.R.; Amdam, G.V.; Trumble, J.J.; Smith, B.H. Acute sublethal exposure to toxic heavy metals alters honey bee (*Apis mellifera*) feeding behavior. *Sci. Rep.* **2019**, *9*, 4253. doi:10.1038/s41598-019-40396-x.