ECAS-7 2025 Conference

The 7th International Electronic Conference on Atmospheric Sciences

04–06 June 2025 | Online

MDPI

Occurrence of persistent chemical pollutants, heavy metals, in regions influenced by different human activities by means honey matrix.

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INTRODUCTION & AIM

While flying, the insect’s body may absorb pollutants from its surroundings [1]. At the same time, environmental contaminants present in sources such as pollen, nectar, and water can be transferred to bee products [2]. Bees and honey represent an economical and effective approach for environmental biomonitoring. Thanks to their natural behavior and foraging range, they can help detect the presence of pollutants within a radius of approximately 1.5 to 3 kilometers around their hive, making them valuable indicators of local environmental contamination [1]. Inorganic pollutants known as heavy metals originate from both natural sources and human activities like mining, metal processing, vehicle exhaust, and cosmetic manufacturing. These substances pose health risks because they promote the formation of reactive oxygen species (ROS) and interfere with essential physiological functions [3]. This study aims to detect heavy metal contamination in honey, not only to ensure its safety for consumption but also to monitor environmental pollution in certain areas, underscoring how honey reflects the quality of its surrounding ecosystem.

METHOD

Sampling

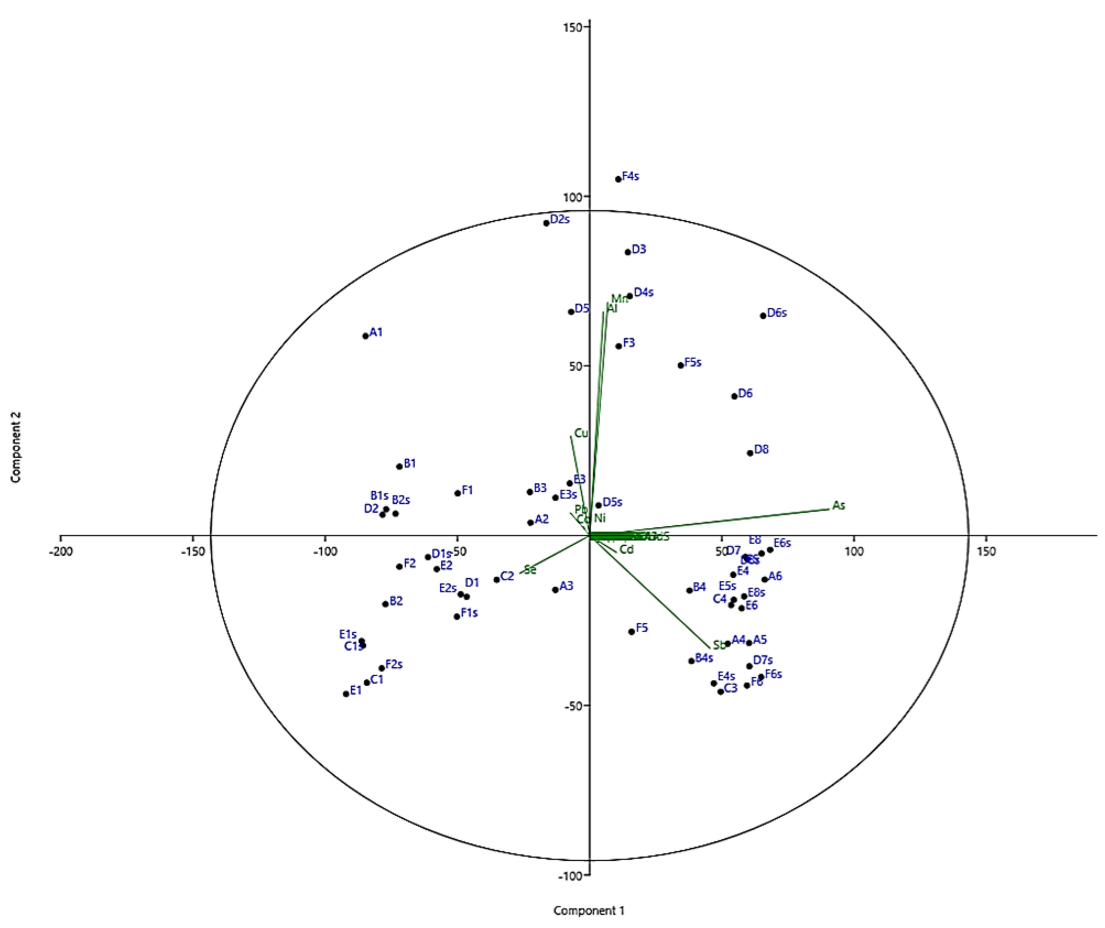
Honey samples were collected from six locations in the Molise Region (Italy) between June and September 2021. A total of 56 samples, taken directly from honeycombs with and without smoker use, were stored properly until analysis.

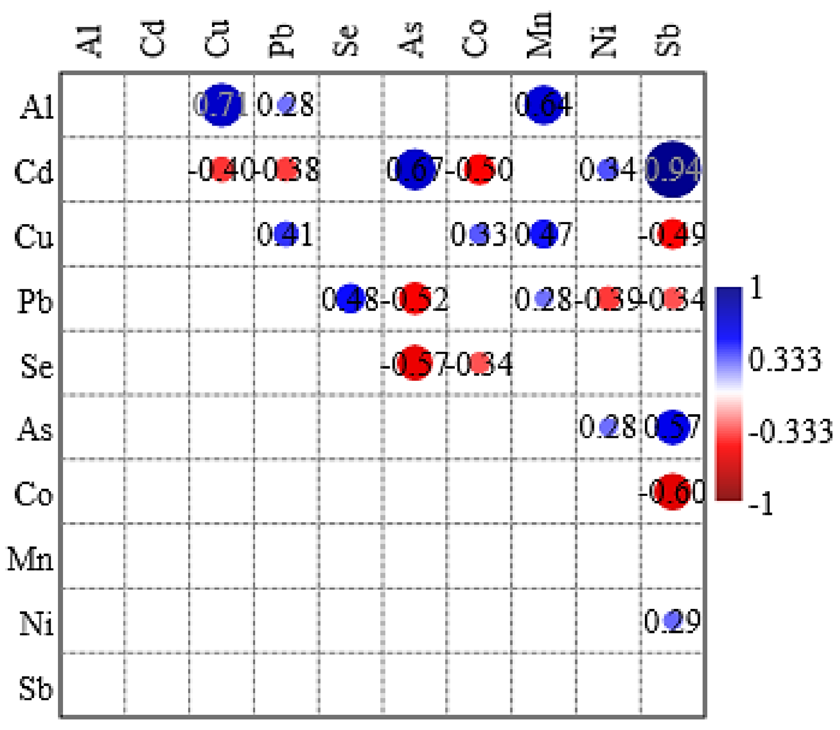
ICP Analysis

Honey samples were mineralized using nitric acid and microwave digestion to remove organic material. Specifically, 0.5 g of each sample was diluted with ultrapure water to 25 mL, then homogenized using vortex mixing and ultrasound treatment. After the addition of 10 mL of 65% HNO_3, the samples underwent microwave-assisted digestion at 600 W for 20 minutes in sealed vessels. The resulting solutions were filtered, brought to volume with ultrapure water, and analyzed for heavy metals (Al, As, Cd, Co, Cu, Mn, Ni, Pb, Sb, Se) using ICP-AES according to EPA Method 6010C, with quantification based on calibration curves.

RESULTS & DISCUSSION

Principal component analysis (PCA) was performed to reduce the number of variables without losing information. The scree plot suggested considering five principal components (PCs) with eigenvalues above 1. However, only two PCs were sufficient, explaining 74.35% of the data variance, specificallyPC1: Cd, As, Sb; and PC2: Al, Cu, Mn.





Pearson correlation coefficient was used to analyze relationships between the elements. Significant positive correlations ($p < 0.05$, $r > 0.7$) were found between Sb and Cd, and between Cu and Al. These findings suggest shared sources or similar patterns of these metals in the honey samples.

The correlation between antimony and cadmium is due to shared anthropogenic sources like mining waste leaching, metallurgical processes, and improper disposal of plastics and electronics. Copper and aluminum contamination arise from similar human activities including waste incineration, fossil fuel combustion, mining, and traffic. Copper pollution is linked to forest fires, industrial products, and poor waste management. Their co-occurrence is likely influenced by summer forest fires and ongoing vehicle emissions.

CONCLUSION

This study highlights improper electronic waste disposal, vehicle traffic, and forest fires as key sources of atmospheric pollution. Heavy metals from these sources can accumulate on plants, water, and bees. This contamination impacts the quality of pollen and nectar. Consequently, the honey produced by bees is also affected.

REFERENCES

[1] Di Fiore, C.; De Cristofaro, A.; Nuzzo, A.; Notardonato, I.; Ganassi, S.; Iafigliola, L.; Sardella, G.; Ciccone, M.; Nugnes, D.; Passarella, S.; et al. Biomonitoring of Polycyclic Aromatic Hydrocarbons, Heavy Metals, and Plasticizers Residues: Role of Bees and Honey as Bioindicators of Environmental Contamination. *Environ Sci Pollut Res* **2023**, *30*, 44234–44250, doi:10.1007/s11356-023-25339-4.2.

[2] Nowak, A.; Nowak, I. Review of Harmful Chemical Pollutants of Environmental Origin in Honey and Bee Products. *Critical Reviews in Food Science and Nutrition* **2023**, *63*, 5094–5116, doi:10.1080/10408398.2021.2012752.

[3] Duruibe; Ogwuegbu; Egwurugwu Heavy Metal Pollution and Human Biotoxic Effects. *International Journal of physical sciences* **2007**, *2*, 112–118.