

Assessment of honey quality and its correlation with soil contamination by heavy metals

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Abstract

- ❑ The quality of honey are increasingly influenced by environmental factors. Particularly soil contamination by heavy metals and minerals. This study aimed to assess the quality of honey in terms of physicochemical properties, and correlation with soil contamination by heavy metals.
- ❑ Two sampling sites were selected: One near an artisanal mining zone and another in an agricultural area. Soils and honey samples were taken and analyzed for heavy metals content specifically arsenic (As), lead (Pb), cadmium (Cd) and mercury (Hg) using X-Ray Fluorescence (XRF). Additionally, the physicochemical parameters of honey, including pH, moisture content, relative density, refractive index, brix value, total ash content and electrical conductivity were evaluated.
- ❑ The results revealed that honey samples collected near the mining site exhibited significantly elevated levels of cadmium and mercury. But in contrast lead and arsenic were not detected in honey while arsenic was found with limit range in soil.
- ❑ The findings support the use of honey as a potential bioindicator of soil contamination and provide insight for policymakers, beekeepers and environmental health practitioners in developing sustainable agricultural and apicultural practices.

Introduction

Honey is a complex natural product made by bees from the nectar of plants. Its composition is influenced by various factors, including the types of plants the bees forage on, environmental conditions, and the handling of the honey after harvesting.

Honey’s chemical composition includes water content, sugars (mainly glucose and fructose), proteins, vitamins, minerals, and enzymes. Additionally, its quality is often evaluated using parameters like moisture content, relative density, Refractive index, Brix, total ashes (Ghosh, Mandal, & Bhattacharyya, 2019). The picture shows the honey sample that analyzed for its quality.



Methods used

Materials used for sampling and in laboratory

Soil sampling	Honey sampling	Laboratory
✓ Sampling Probe	✓ Sterile Glass Jars or Containers	✓ Oven
✓ Sterile Plastic Bags	✓ Labels	✓ Pycnometer
✓ Shovel or Trowel	✓ Sterile Glove	✓ Spatulas
✓ Plastic Containers	✓ Sterile Sampling Spoons	✓ Cheesecloth
✓ Measuring Tape	✓ Field Notebook	✓ Analytical balance
✓ Labels		✓ X-ray fluorescence
✓ Sterile Gloves		✓ pH meter and conductometer
		✓ Refractometer

- ❑ **Heavy metal analysis:** X-ray Fluorescence (XRF) was used for conducting soil and honey test for the presence of heavy metals such as lead (Pb), cadmium (Cd), mercury (Hg), and arsenic (As). X-ray Fluorescence (XRF) works by bombarding the wax sample with primary X-rays, which excite the atoms in the sample. When the atoms relax back to a lower energy state, they emit secondary (fluorescent) X-rays that are element specific. The XRF detector captures these emitted X-rays, and their energy and intensity are used to identify and quantify heavy metals like Pb, Cd, or Zn present in the sample
- ❑ For the determination of physicochemical parameters (including pH, moisture content, refractive index, Brix, and electrical conductivity), liquid honey samples were pre-treated by warming in a water bath at 40°C. This process ensured homogenization and reduced crystallization without altering the chemical integrity of the samples. All measurements were conducted immediately after temperature stabilization.

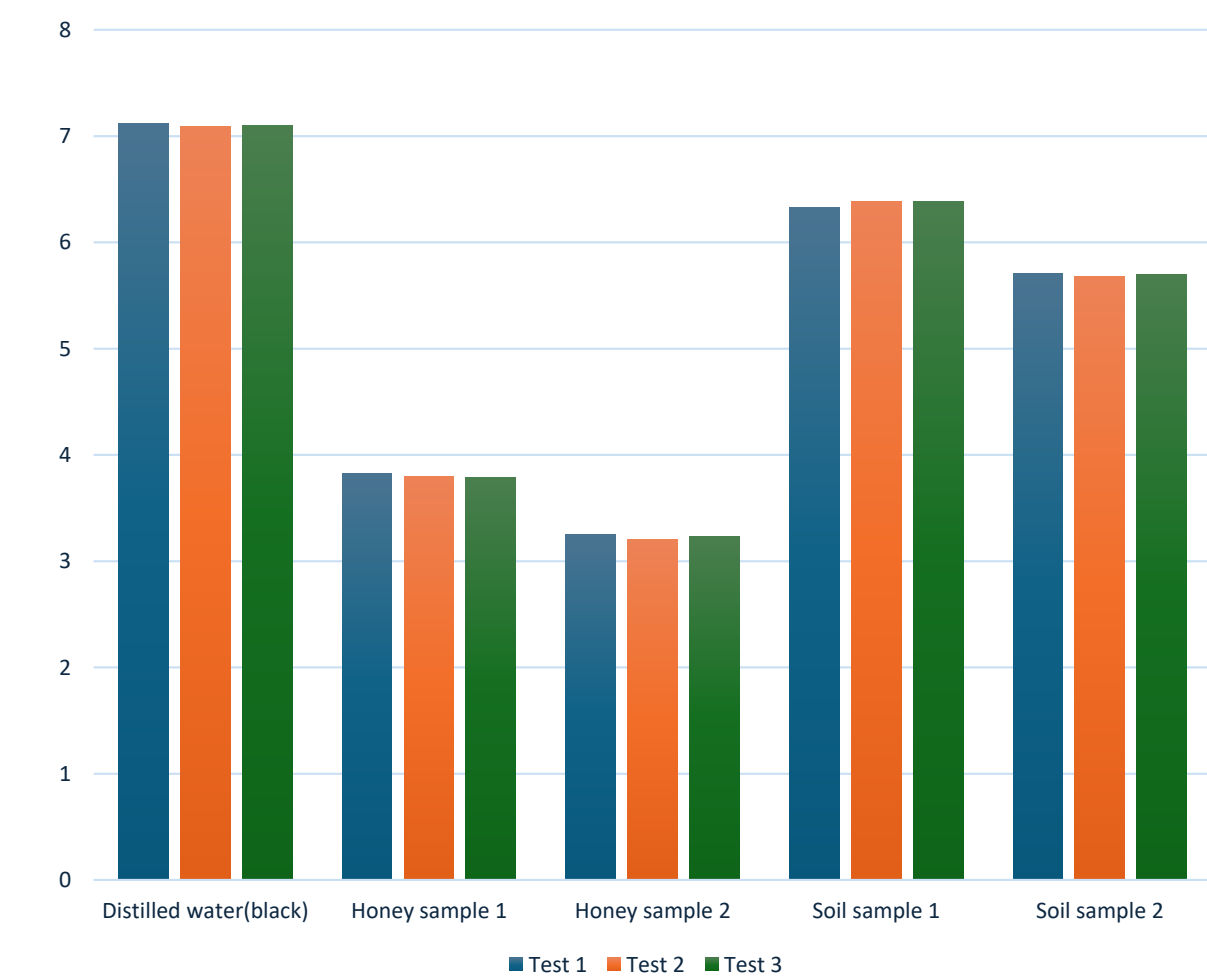
Results

Refractive index of honey samples

Honey sample	1 st trial%	2 nd trial%	3 rd trial%	Average RI %
1	1.4971	1.4973	1.4970	1.4971
2	1.4980	1.4990	1.4989	1.4986



pH Test for honey and soil samples



Conductivity of honey and soil sample

Sample	1 st (µs/cm)	2 nd (µs/cm)	3 rd (µs/cm)
Distilled water	7.44	7.19	7.08
Honey sample 1	472	474	476
Honey sample 2	504	501	504
Soil sample 1	147.6	148.6	146.0
Soil sample 2	139.0	139.0	139.0

Conclusion and Recommendations.

From the study conducted, Heavy metals such as cadmium (Cd), lead (Pb), and mercury (Hg) were detected in both soil and honey samples, with notably higher concentrations in honey collected near the mining site. physicochemical properties such as pH, electrical conductivity, Brix, refractive index, moisture content, and relative density varied between samples. Honey from the mining zone exhibited higher acidity, electrical conductivity, and sugar concentration factors likely influenced by soil conditions and environmental stress. These findings suggest that environmental pollution not only affects the safety of honey but also alters its physical and chemical characteristics. Regular tests of soil and honey recommended.

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