Elemental Analysis of Honey to Detect Pollution

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The pollution of the environment by humans has been exponentially growing. Factories and vehicles spewing out noxious fumes poison the air that we breathe. Liquid waste and discharges from factories and communities into water bodies pollutes rivers, lakes, and groundwater.

When food is grown using polluted groundwater for irrigation or where the air is contaminated, there is a high likelihood that the grown fruits, vegetables, grains, and crops are also polluted.

Among the several methods of monitoring environmental pollution, analyzing foods is one method of keeping a tab on pollution. The analyses performed may include chemical analysis to detect chemical contaminants such as heavy metals, and biological analysis to detect biological pollutants such as harmful microorganisms. Honey is one food that can be analyzed to detect pollution.

Detecting Pollution Using Honey

Bees produce honey by converting the nectar that they take from flowers. They also drink water and breathe in air, which may be polluted. Since bees generally fly around and visit a large number of flowers in a small radius from their hive in search of nectar, they can be used to monitor pollution over local, and small areas.

Using chemical analysis techniques, various hazardous compounds can be detected, giving an indication of the environmental pollution in the area. Bees have been used for a long time in monitoring pollution. For example, a study published in 1975 reported elemental analysis of honey to detect whether honey produced near highways or industrial areas was polluted.[1]

Using spark source mass spectrometry, the authors found that the honey collected from nearby highways contained elements such as barium, nickel, and silicon, which are generally known to be produced by traffic.

Recently, several other methods of elemental analysis have been used to detect pollutants in honey. Most methods usually detect heavy metals. Some heavy metals like iron, manganese, and nickel are important for human growth in low concentrations. However, several metals such as lead, cadmium, chromium, and mercury are extremely toxic, even at low concentrations in the body.

Metals in honey can be present if the hives are located close to factories, highways, mines, or other industrial areas. One study used inductively coupled plasma-optical emission spectrometry (ICP-OES) to detect the presence of metals in honey.[2]

The samples were treated first to remove most of the organic matrix using solid phase extraction or wet digestion. The ICP-OES uses a plasma to convert the elements to their respective atoms and ions that emit characteristic radiations which are then used to identify them.

Another study examined trace elements present in honey produced on reclaimed uranium mining land in Texas, USA.[3] Honey samples obtained from the reclaimed land were analyzed by the use of neutron activation analysis. This technique uses minimal sample preparation and the samples are irradiated with neutrons.

This produces radioactive isotopes and the elements can be identified by their

characteristic decay signature. The study found that the heavy metal content of the honey samples was comparable to those found in commercially accepted honey.

Apart from heavy metals, analysis of honey can also be used to detect environmental contamination by pesticides and other persistent organic pollutants (POP).

Researchers in Italy used gas chromatography-mass spectrometry (GC-MS) to detect pollutants in honey produced in three different areas of Italy.[4] Solvent extraction was first used to extract the organics, which were then analyzed using the GC-MS.

Honey can also be used to detect pollution by radioactive materials. A team of researchers analyzed honey produced in Poland to see if it had been contaminated by radioactive materials after the Fukushima nuclear plant disaster in Japan.[5]

Most radioactive materials produce gamma rays that are characteristic of each material. So, the researchers used gamma-ray spectrometry to determine that the amount of radioactive materials did not increase in Polish honey after the disaster.

Conclusion

Honey from bees can be a powerful indicator of environmental pollution, particularly when the samples are taken in a small area close to the hives.

However, an important factor when analyzing the presence of pollutants in honey is to understand how the plants uptake the pollutants when the bees take nectar from them, and which parts of the plant body the pollutants are concentrated in.

In addition, it is important to ensure that the analytical techniques used to detect pollutants are performed carefully once the applicability of the technique has been verified.

References and Further Reading

1. Tong et al., *Archives of Environmental Health*, **1975**, *30(7)*, 329.
2. Mejias and Garrido, http://dx.doi.org/10.5772/66328
3. Iskander, *Science of the Total Environment*, **1996**, *192(1)*, 119. https://doi.org/10.1016/0048-9697(96)05293-X
4. https://assets.thermofisher.com/TFS-Assets/CMD/Application-Notes/CAN-125-GC-MS-Pollutants-Honey-CAN72132-EN.pdf

5. Borawska et al., *Bulletin of Environmental Contamination and Toxicology*, **2013**, *91(5)*, 489. https://link.springer.com/article/10.1007%2Fs00128-013-1089-1

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