

# COMPARISON OF MPAES AND ICP-MS FOR THE DETERMINATION OF POTENTIALLY TOXIC ELEMENTS IN (POLLUTED) PLANT MATERIAL

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## 1. Introduction

Pine needles have been studied worldwide, particularly in areas affected by heavy metal pollution from traffic and industrial activities. These studies aim to assess the extent to which pine needles can serve as bio-monitors of environmental contamination, especially with heavy toxic metals and due to them being present all year round. Another type of contamination from heavy metals can arise, for example, from shooting ranges [1].

Shooting ranges play a crucial role in providing a controlled environment for firearm enthusiasts and professionals to practice their skills. However, the environmental consequences of shooting range activities often go unnoticed. The discharge of lead and other heavy metals poses a serious threat to ecosystems and public health. An old closed Shooting Range named Munkatorp Shooting Range, located in Sweden Örebro, has been looked at closely for causing heavy pollution specifically heavy metals. There are plans to decontaminate the area, but so far, no action has been taken. One of the most significant pollutants associated with shooting ranges is lead. The primary source of lead contamination is ammunition, as bullets are typically made of lead or contain lead components. When fired, these bullets release lead particles into the environment, contaminating the soil and water. Over time, the accumulation of lead in the ecosystem can have detrimental effects on plants, animals, and even human health [2].

## 2. Objectives

Since the area is a former shooting range. The objective of this study is:

- Analyze the pine needles from the possibly affected area and assess the concentrations of different metals.
- The selection of metals for analysis will be determined based on the composition of the bullets such as Lead, Antimony, Copper, Nickel, etc.
- Since there are no specific guidelines on the levels of metals in pine needles, we will compare our results with a Standard Reference Material (SRM), specifically using NIST 1575a as our reference material.

## 3. Method

Four sampling points were identified within the Munkatorp shooting range, and pine needle samples were collected for analysis. Before initiating the analysis, the needle samples underwent a thorough preparation procedure. Initially, the pine needle samples were washed with nitric acid solution, followed by drying in an oven until reaching a constant weight. The needles were then homogenized into a powder using a mortar and pestle. Triplicate preparations were made for each of the four distinct needle samples, and these preparations underwent a digestion method. The digestion method is an open digestion technique, wherein the samples were heated using a water bath. The solution used in this process consisted of nitric acid, MilliQ water, and hydrogen peroxide. Hydrogen peroxide was added every hour to compensate for its consumption during the process. The samples were considered complete when all the pine needles had completely dissolved in the solution. The digestion solutions were then diluted with MilliQ water and finally filtered using a syringe with a 0.2  $\mu\text{m}$  filter.

## 4. Instruments to be used



MPAES



ICP-MS

The instruments to be employed are MPAES and ICP-MS. The preliminary analysis will be carried out using ICP-MS to identify the various metals present in the digestion solution, determining the necessary extent of sample dilution to ensure results surpass the Limit of Detection (LOD), while avoiding plasma overload in the ICP-MS. Subsequently, the actual samples will be diluted based on the outcomes of the initial analysis, and the selection of metal analytes will be guided by the identified metals. Following this, an optimization process will be implemented for the MPAES analysis method to re-examine the digestion solutions with specifically chosen metal analytes. These results will then be compared with those obtained through ICP-MS using statistical calculation methods.

## 5. Results

The results obtained from ICP-MS and MPAES will be presented in their respective bar diagrams and compared with the Standard Reference Material (SRM) to assess any concentration increases in various metals. A statistical analysis will be conducted, specifically using paired t-tests and ANOVA, to evaluate the data further.

### References

- [1] Zeiner M, Juranović Cindrić I. Accumulation of Major, Minor and Trace Elements in Pine Needles (*Pinus nigra*) in Vienna (Austria). *Molecules*. 2021 Jan;26(11):3318.
- [2] Bai J, Zhao X. Ecological and Human Health Risks of Heavy Metals in Shooting Range Soils: A Meta Assessment from China. *Toxics*. 2020 May 1;8(2):32.

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