

**A STUDY ON THE DETERMINATION OF GUNSHOT RESIDUES BY
GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY**

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THESIS ABSTRACT

Title : Determination of Gunshot Residue by Graphite Furnace Atomic Absorption Spectrophotometry

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Statement of the Problem

This study aimed to determine the concentration of gunpowder residues on the hand of a person who has recently fired a gun. The objectives were:

1. To determine quantitatively the amount of trace metals- antimony, barium and lead on the hands of those who fired a gun.
2. To determine quantitatively the above-mentioned trace metals from the hands of those persons prior to firing a gun.
3. To establish a relationship between the concentration of elements before and after test firings.
4. To determine the minimum amount of trace metals that could show whether or not the person fired a gun.
5. To establish a relationship on the concentration of the trace metals in terms of the firearm used.

Experimental Procedure

The study was done at the Forensic Chemistry Division and Firing Range of the National Bureau of Investigation, Taft Ave, Manila. All subjects were right-handed forensic chemists of the bureau. Two (2) types of firearms were used - a 9mm automatic pistol and a 0.38 caliber revolver. Twelve (12) and ten (10) shooters fired the respective handguns.

Swabbings with 0.2% HNO_3 from the left and right hands of dorsal and palmar aspects were taken before and after firing. Washing of the hands in cold running water was done before taking the samples. The samples were soaked overnight and further digested the next day for 30 minutes at 80 - 90 °C. It was cooled at room temperature, agitated, centrifuged, decanted into the analyzer cup and analyzed using a graphite furnace atomic absorption spectrometry. The gunshot residues determined were of antimony, barium and lead. The results of analysis were evaluated using the t-test for means to find out significant levels of difference.

Findings

The results of the investigation revealed the following:

1. The concentrations of the gunshot residues - barium, antimony and lead can be determined quantitatively by graphite furnace atomic

absorption spectrometry. That a comparison between the results of concentration before and after firing showed significant difference for lead and antimony. No significant difference existed for barium.

2. A concentration of 0.113 $\mu\text{g/ml}$ Pb and 0.067 $\mu\text{g/ml}$ Sb are indicative that a person could have fired a gun. The Pb value is much lower while Sb has almost the same value as the current standard used by a U.S. Crime Laboratory. No significant difference existed for barium.
3. There was no significant difference in GSR concentrations whether one uses a 0.38 caliber revolver or a 9mm automatic pistol.

Conclusions

Based on the results of the study, the following conclusions were made:

1. GSR analysis by graphite furnace AAS is more sensitive than the diphenylamine-paraffin method. It can measure the amount of trace element with a minimum sample volume requirement.
2. The minimum concentrations of trace metals that has been established for Sb and Pb which are 0.067 and 0.113 $\mu\text{g/ml}$ respectively could signify that a person had fired a gun. Barium, however is not a conclusive factor.

3. **Results of GSR analysis cannot determine the type of firearm used in terms of whether it is an automatic or revolver type handgun. There was no significant difference observed. This is an advantage over the traditional test which would often give negative results for automatic firearms even if the person indeed had fired.**
4. **The sampling method for the analysis of GSR by GFAAS is simpler than the traditional method.**

Recommendations

Based on the findings of the study, the following recommendations are hereby suggested:

1. **The sensitivity of barium to the method used should be further studied. It is important to note that studies abroad showed significant level of barium concentration in GSR analysis.**
2. **The method should be improved in terms of the following:**
 - a. **Experiment conditions such as the variation of temperature programs in the different stages, volume of samples injected, dilutions and other parameters.**
 - b. **The use of chemical modifiers that could enhance the sensitivity of the trace metals being analyzed.**
 - c. **The sampling extraction and digestion methods.**

3. **An increase on the number of subjects to be analyzed using both firearms. Similarly, to use additional 0.38 and 9mm handguns for test firing should be done.**
4. **The analysis of other kinds of handguns for both revolvers and pistols.**
5. **The analysis of more occupational handblanks in order to determine which profession could have a high level of one or two of the elements present in GSR.**

