

"THE DETERMINATION OF TRACE HEAVY METAL POLLUTANTS
IN HUMAN AND ENVIRONMENTAL SAMPLES USING
DIFFERENTIAL PULSE ANODIC STRIPPING VOLTAMMETRY
AND ATOMIC ABSORPTION SPECTROPHOTOMETRY."

THIS THESIS HAS BEEN ACCEPTED FOR
THE DEGREE OF M.Sc. 1987
AND A COPY MAY BE PLACED IN THE
UNIVERSITY LIBRARY

By

ISAAC O. JUMBA

A thesis submitted in partial fulfilment
for the degree of Master of Science of
the University of Nairobi.

ABSTRACT

The classification of trace elements into essential or non-essential biological metals depends on their role in the living organism. For this matter, the very important environmental aspects of zinc, mercury, copper, lead and cadmium have been reviewed and a summary presented.

Several analytical techniques are available for use in heavy metal pollution monitoring. However, two methods namely differential pulse anodic stripping voltammetry (DPASV) and atomic absorption spectrophotometry (AAS), were comparatively used in this study for the determination of the trace element composition of hair as a reliable indicator of the total heavy metal contamination of Kenyan people.

Factors affecting the determination of the metals were studied and best conditions for analysis established. It was found that polarographic analysis was sensitive to pH when samples were dissolved in acidic media. The optimum pH for the analysis of lead, copper and zinc, cadmium were 1-3 and 6-7, respectively. The peak current and peak position were also suppressed by iron (III) but this interference was minimized with the addition of hydroxylamine hydrochloride. The effect of matrix concentration in the quantitation procedures

was reduced by dissolving smaller weights. Finally, the interference of Selenium (IV) was eliminated by addition of ascorbic acid.

Good detection limits were obtained under the optimum conditions employed, viz: 0.0269, 0.0287, 0.00365 and 0.02306ng/cm³, respectively for copper, lead, cadmium and zinc using DPASV. DPASV showed higher sensitivity over AAS. Furthermore, polarographic analyzer instruments are less expensive than AAS. The two reasons led us to believe that DPASV can function as a useful complement to, or a replacement for AAS in the analysis of heavy metals.

The 265 samples analyzed were randomly collected from 53 persons coming from the following provinces of Kenya:- Western, Coast, Nairobi, Eastern, North Eastern, Rift valley, Central and Nyanza. The eating habits, work places, and level of exposures to heavy metal pollution differed according to individual's educational, religious, and tribal backgrounds. A few isolated cases were detected with abnormally high lead and mercury concentrations in the hair compared to the mean. The high concentrations were attributed to external exposures either from body beauty creams or lead fumes. The analysis of fourteen body lotions and body creams commonly sold in Kenya showed mercury concentrations in the range of 0.222 to 4.92µg/g thus confirming our

conclusions. The mean hair values for the samples analyzed were 12.2, 196, 24, 52 and 2.22 μ g/g respectively for mercury, zinc, copper, lead and cadmium. These values if statistically projected to reflect the Kenyan population would reveal a low pollution level in Kenya. Comparing these data with those reported for populations in other countries, it can be concluded that the Kenyan environment is relatively less polluted.