

A note on urinary Cd, Cr, Mn and Pb, in students of the University of Agriculture Makurdi, Nigeria

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ABSTRACT

A preliminary investigation of heavy metals exposure of students of the University of Agriculture, Makurdi in Central Nigeria involved AAS analysis of urine from ten (10) of the students (five each of female and male volunteers). Results indicate that the concentrations of Cd, Cr, Mn and Pb showed no discrimination between female and male students. In general the concentration of these metals was in the order $Mn > Cr > Pb > Cd$, at levels that raise some concern about the health risks associated with heavy metals, for the subjects. It is concluded that these students are or have been exposed to the same or similar sources of these heavy metals.

INTRODUCTION

Although components of the earth's crust, the presence of (especially toxic) heavy metals in the living environment of humans has remained topical globally¹. This is largely because, once released into the environment through human activities, they end up in the bodies of humans and other organisms, through various processes including inhalation, ingestion and skin absorption². Heavy metals overload can lead to various negative health effects like neurological disease, depression, vital organ failure, etc.; their accumulation can also aggravate other serious physiological and organ disorders³. Although Nigeria is not yet an industrial nation, heavy metal contamination of its environment may occur due to irrigation with contaminated water, the addition of chemical fertilizers

and metal-based pesticides, small- and medium-scale industrial emissions, etc.⁴. Considering all these, we embarked on a survey of heavy metals exposure of University students as a discrete population group in Nigeria. This is a preliminary report using urine which was sampled from five female and five male students of the University of Agriculture, Makurdi in Central Nigeria and analyzed for Cd, Cr, Mn and Pb only, using AAS.

MATERIALS AND METHODS

Sample collection

Urine samples (early morning voids) were collected, in brown sample bottles, from

ten adult volunteers –five female and five males residing in the Student Hostels and Off-Campus and stored in the refrigerator to guarantee the integrity of the samples at the point of analysis.

Digestion of samples

Ten (10) millilitres of urine sample were measured via pipette into a 150mL beaker to which were added 10mL 1:1HNO₃. The mixture was covered with a watch glass and gently heated to reflux for 10-15 minutes without boiling on a regulated hot-plate. This was brought down and allowed to cool slightly and 15mL conc. HNO₃ added. The mixture was returned to the hot-plate and allowed to reflux for 80mins. Thereafter, the watch glass was removed and the digest allowed to evaporate (without boiling) to about 5mL. It was brought down, allowed to cool to room temperature. Two (2) millilitres distilled deionized water (DDW) and 3mL 30% H₂O₂ were added. The mixture was, again, returned to the hot-plate until the effervescence was minimal. It was brought down, allowed to cool slightly and 5mL conc. HCl and 10mL DDW added. The mixture was returned to heat under reflux for 15 minutes. The digest was finally allowed to cool and the volume made up to 100mL with DDW. This was reserved for analysis by Atomic Absorption Spectroscopy (AAS) using a Buch Scientific AAS Model 210 VPG.

RESULTS AND DISCUSSIONS

Table 1 summarizes the results of the AAS determinations for Cd, Cr, Mn and Pb for both male and female students of the University. Urine is a minor excretory route for heavy metals in humans (the primary route being faeces)⁵, therefore the presence of significant amounts of these metals in urine is probably suggestive of severe exposure to these metals⁶ and should be a cause for concern (especially Cd and Pb). The table shows that there is probably no significant difference in the level of accumulation between males and females, which is suggestive of similar exposure sources the individuals are exposed to. In both groups, higher levels of Mn and Cr are observed with the order of metal accumulation being Mn > Cr > Pb > Cd. Since uptake of Mn by humans is mainly through food such as vegetables, rice and other grains, etc², the predominance of this metal over the others is understandable.

While dietary intakes of Cr cannot be reliably determined because the content of the mineral in food is substantially affected by agricultural and manufacturing processes, and perhaps by contamination⁷, the relatively high concentration of this element in the samples may be a result of reduction of the body's Cr content, which tends to be reduced under several conditions; for example, in diets high in simple sugars which increase the excretion of Cr in urine⁸. Most of these University students (largely indigent) are known to live on carbohydrate-rich and hardly balanced diets. Exposure to Cd and Pb are

Table 1. Concentration of Cd, Cr, Mn and Pb in the urine of some students of the University of Agriculture, Makurdi, Benue State in Central Nigeria

Sample	Concentration (mg/L urine)			
	Cd	Cr	Mn	Pb
Males				
M1	0.10	8.9	32.9	0.30
M2	0.30	7.5	22.5	1.1
M3	0.30	6.8	11.8	0.90
M4	0.50	3.3	8.30	2.1
M5	0.040	7.9	12.3	1.2
Mean±SD	0.25±0.16	6.9±1.9	17.6±9.0	0.93±0.67
Order of metal accumulation: Mn > Cr > Pb > Cd				
Females				
F1	0.20	9.9	14.9	0.20
F2	0.40	5.9	20.9	1.5
F3	0.20	9.5	14.5	0.30
F4	0.40	7.3	12.3	0.20
F5	0.60	9.2	31.0	2.9
Mean±SD	0.30±0.19	8.4±1.5	18.7±6.8	0.85±1.0
Order of metal accumulation: Mn > Cr > Pb > Cd				

clearly due to environmental contamination with these elements.

CONCLUSION

This preliminary investigation showed that students of the University of Agriculture, Makurdi, Benue State in Central Nigeria are definitely exposed to heavy metals which are detectable in their urine. No gender relationship to the accumulation of these metals is indicated in this limited study. In this study more Mn and Cr showed accumulation than Cd and Pb, the order being Mn > Cr > Pb > Cd. We recommend that a more detailed study should be made with a higher population size and across University campuses in Nigeria for a more in-depth knowledge of the exposure of University students to heavy metals. This will provide an informed advisory on their living conditions and diets, considering that this population group holds the key to Nigeria's future prosperity.

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