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An Investigation into the Effect of Vehicle Exhaust Fumes on the Levels of Some Heavy Metals in Cows' Blood

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Abstract: Heavy metals contamination is of concern due to their effects as carcinogen. The objective of this study was to investigate the heavy metals in the blood of cows exposed to motor vehicle exhaust fumes and non-exposed controls. Thirty cows' blood samples were collected from three different locations (Expressway, Araromi way and Federal College of Agriculture, livestock section (FECA), wet digested and analyzed with atomic absorption spectrophotometer. The mean level in Araromi way cow's blood was 2.85 mgL^{-1}, which was significantly higher them the levels of 1.43 mgL^{-1} in expressway and 1.33 mgL^{-1} obtained in the control (FECA). However, results revealed significant difference ($p<0.05$) In the Co, As, Ni and Cr levels between the exposed and non-exposed cow's blood samples. Highest correlations were found between Pb and Co. Blood variables were not affected by exposure to motor vehicle exhaust fumes.

Key words: Cow blood, motor vehicle exhaust fumes, heavy metals, haematocrit, environmental pollution

INTRODUCTION

Heavy metal exposure is a public health concern in Nigeria due to the increasing evidence concerning the effects of these metals on the cognitive development of the populace especially, the young ones[1]. The number of people living in cities worldwide increased dramatically during the last part of the 20th century. According to Chirenje *et al.*[2], more then a third of the world population lived in cities. This trend continues to increase at an unprecedented pace. Such rapid urbanization, however, comes at a cost. Observable effects found at levels formerly thought to be safe has prompted a worldwide re-evaluation of environmental trace metals controls and the health risk associated with metal contaminated environments, some heavy metals are reported to be useful in biochemical activities in the body, while some are extremely dangerous to human and animal health. A large number of deaths or deformations still occur from the poison of animals, especially in their young ones[3,4].

Human and animal derive their supply of heavy metals from contaminated food, water, air and soil. There is general agreement that for young ones, the relative contribution to biological fluids from ingestion is greater than that from inhalation. Heavy metals in biological fluids have been used as important indicator of the environmental pollution[5-8].

Reports from different parts of the world have shown that people who are constantly exposed to motor vehicle exhaust fumes have significantly higher blood heavy metals concentration them non-exposed controls. In this study, we report heavy metals in the whole blood of cows exposed for motor vehicle exhaust fumes and matched controls. The controls have no exposure to vehicle exhaust fumes.

MATERIALS AND METHODS

The samples included thirty randomly selected cows, which ranged from calves to adult, were obtained in cattle ranches from Araromi way, expressway and livestock section of Federal College of Agriculture (FECA) Akure, Ondo State, Nigeria in March 2005. 5cm^3 of whole blood was collected from each cow into polyethylene hepanised container with polyethylene syringes and butterfly needles. The first 1cm^3 of blood was allowed to run into an EDTA bottle to wash off any metal contamination of the steel needle.

The haematocrit of each cow was determined by the microhaematocrit technique. Samples were wet ashed using HCL/HNO_3 (1:1) until clear solution was obtained (10cm^3), this was made up to 50cm^3 with 2M HCL. Heavy metals wee subsequently analyzed with an SP 1990 Pye Unicam atomic absorption spectrophotometer. Results were subjected to statistical analysis using SPSS for windows 10.

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RESULTS AND DISCUSSION

The heavy metal composition of blood samples varied with type of blood (Table 1). The mean Co of blood sample was 4.55 mgL^{-1}. The overall mean compositions (mgL^{-1}) of the samples were 1.90, 2.42, 5.77, 3.27 and 5.00 for Pb, As, Ni, Cr and Se respectively. The Co and Pb values were significantly higher in Araromi way compared to expressway and FECA values. The main reason for numerical higher Co and Pb values in Araromi way might be attributed to the exposure of vehicular fumes. This area of the city has high traffic congestion. In addition, the cows have had significantly longer exposure to vehicle exhaust fume compared with other places. The higher values of Cr and Se in the FECA blood samples (control) could be explained that rural communities (non-exposed to vehicle exhaust fumes) are equally prone to metals contamination possibly from non-source points and other human and animal activities. In this study, the obtained Pb values of all the blood samples were relatively higher to the 9.6 mg dL^{-1} and 12.23 mg dL^{-1} reported by Saito *et al.*,[9] (Japan) and Haeger-Aronsen[10], (Sweden). The lower levels recorded for the two countries might be due to the Pb content of petrol, 0.5g/L^{-1} in Sweden and 0.31gL^{-1} in Japan. The Pb result was lower in the present study than the results by Aggarwal *et al.*,[11] in India. Bo *et al.*,[12], found consistent findings to our study with respect to Ni values. Adeniyi and Olawoore[8] reported the findings with regard to Ni and Pb in urine samples similar to our result in Lagos, Nigeria.Ogunsola *et al.*,[13] observed moderately consistent results to our study with respect to As (2.01 mgL^{-1}) and Cr (2.19 mgL^{-1}).

The blood trace metal survey conducted by Cowie *et al.*,[5] and Interdepartmental lead taskforce[14] showed that children between 1-4year were more prone to environmental hazard. These findings were similar to ours. Young calves were found to have higher levels than the old cows. The reason might be that young calves tend to lick and chew all the fittings, which in many cases may have residues of these heavy metals and a significant amount of these metals could be absorbed directly through their tender skin.

The heavy metals of particular interest from atomotive pollution considerations are Pb, Ni and Co while As, Se and Cr are marker metals for agriculture contributions. Figure 1 shows the variation of concentrations of these metals among the three different areas. Co and Pb concentrations were highest in Araromi way. As and Ni in the expressway and Cr and Se in FECA. Correlation analysis between selected elements in the blood samples are shown in Table 2. Some metals were correlated with others. The highest correlation in samples (>0.9) was found between Pb and Co. The mean blood variable of cows is shown in Table 3. The PCV values ranged from 37.0-38.6%, RBC (2.4-2.9mm^{-1}) and MCV (113.2-123.6mm3), in all, the parameters measured were not significantly ($p>0.05$) affected by the vehicle exhaust fumes. All the blood parameters were in total agreement with values reported for birds[15].

Table 1: Metal composition of cow blood samples (mgL^{-1} wet weight)

Location	Co	Pb	As	Ni	Cr	Se
Expressway	4.56	1.43	3.64	7.22	3.50	5.00
Araromi way	6.07	2.85	1.82	4.33	2.50	3.33
FECA[a]	3.03	1.43	1.82	5.77	3.80	6.67
Mean	4.55	1.90	2.42	5.77	3.27	5.00
Std deviation	1.52	0.82	1.05	1.45	0.68	1.67
Coff. Variation (%)	33.38	43.07	43.30	25.03	20.84	33.40

[a] FECA-Federal College of Agriculture, livestock section

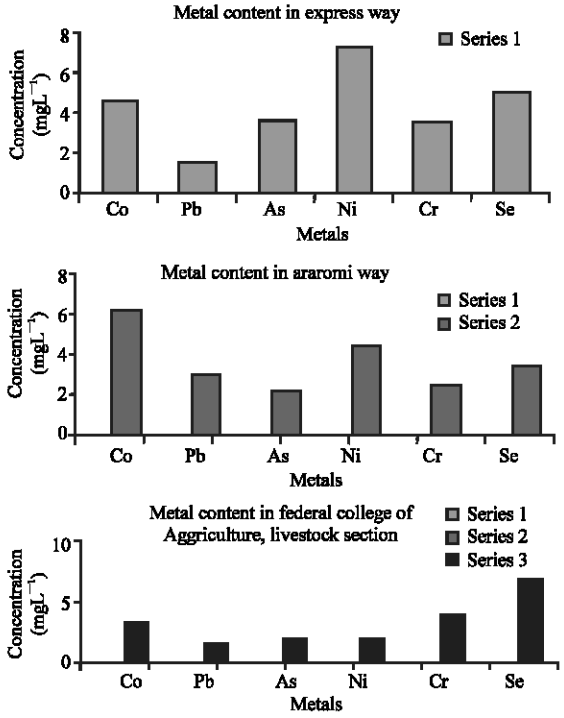

Fig. 1: Variations of concentrations of the metals among the three locations

Table 2: Correlation coefficient of metals in cow blood samples

	Co	Pb	As	Ni	Cr	Se
Co		0.864			0.788	
Pb	0.964				0.800	
As				0.867		
Ni			0.834			0.596
Cr	0.868	0.500	0.700			
Se				0.498		

Table 3: Blood variables of cows' blood samples

Parameter	Expressway	Araromi way	FECA[a]
PCV (%)	37.8±1.3	37.0±18	38.6±1.5
RBC (x$10^{-6}mm^{-3}$)	2.±0.1	2.7±0.1	2.9±0.1
Hbc (g$100mL^{-1}$)	10.0±0.5	11.2±0.6	0.9±0.6
MCV (μm^3)	123.6±8.7	113.2±9.8	118.3±9.2
Lymphocytes (%)	50.6±1.6	46±1.9	47±1.5
Monocytes (%)	3.1±0.3	3.0±0.5	3.1±0.8

[a]FECA-Federal College of Agriculture, livestock section

CONCLUSION

From the study, motor vehicle exhaust fumes contributed significantly to heavy metal pollution of the blood samples and mainly responsible for Pb and other traffic- generated toxic heavy metals. Agricultural activities could have contributed to the heavy metals in non-exposed area (FECA). There is a great need to reduce these metals especially Pb to minimize the hazardous effect on public health particularly of human and animals who are most valuable to traffic pollution.

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REFERENCES

1. Abulude, F.O., E.I. Adeyeye and S.S. Asaolu, 2003. Assessment of some heavy metals in mushroom samples from Ondo State, Nigeria. Int. J. Environ. Studies, 60: 535-536.
2. Chirenje, T., L.Q. Ma, R. Szulczewski, Littell, K.M. Portier and E. Zillioux, 2003. Arsenic distribution in Florida urban soils, J. Environ. Quality, 109: 1-22.
3. Sanisbury, D., 1994. Animal health. Blackwell Sci. Ltd, London, 2nd Ed.
4. Matthews, J., 1999. Disease of the goat. Blackwell Science. Ltd, London, 2L^{-1}nd Ed. pp: 180-181.
5. Cowie, C., D. Black, I. Fraser and M.J. Ferson, 1994. Blood lead levels in 1-4 year old children attending childcare centre in the eastern Sydney area. Abstract presented at the second NSW public Health Network conference, Sidney.
6. Baranowska, I., 1995. Lead and cadmium in human placentas and material and neonatal blood in heavily polluted areas measured by graphite furnace atomic absorption spectrometer. Occupational and Environmental Med., 2: 229-232.
7. Faulkner, J., 1995. Survey finds lower- than-expected blood lead levels in children, media release 30 June 1995. Senator John Faulkner, Minister for environmental sports and Territones, Parliament House, Canberra.
8. Adeniyi, A.A. and I.K. Olawoore, 2002. Flame atomic absorption spectrophotometric determination of trace metals in urine. Pak. J. Sci. Ind. Res., 45: 23-25.
9. Saito, K.T., Y. Sato and Jiizuma, 1993. Effect of low lead concentration on the human body. Ind. Health, 11: 85-87.
10. Haeger-Aronsen, B., M. Abdullah and I.B. Fristedt, 1971. Effect of lead on aminolevulinicacid dehydrase activity in red blood cells. Arch. Environ. Health, 23: 440-445.
11. Aggarwal, A.L., C.V. Patel, C.V. Rayani and S.K. Chaterjee, 1979. Biological effect of airborne lead on occupationally exposed traffic policemen and permanent shopkeepers stationed at Ahmedabad city. Ind. J. Med. Res., 70: 650-656.
12. Bo X. Singeng and O. Choon-nam, 1994. Concentration of cadmium, lead, selenium and Zinc in human blood and seminal plasina. Biological Trace Element Res., 40: 49-57.
13. Ogunsola, O.J., A.F. Oluwole, O.I. Asubiojo, M.A. Durosimi, A.O. Falusi and W. Ruck, 1994. Environmental impact of vehicular traffic in Nigeria health aspects. Sci. Total. Environ., 146/147: 111-116.
14. Interdepartmental lead taskforce, 1994. New south Wales lead management action plan Background papers, environment protection authority, Sydney.
15. Agbede, J.O., 2005. Assessment of performance, haematology and muscle development of broiler-chicks fed wheat offals or rice brawn in place maize in diets with roxazyme-G. Proceedings of 1L^{-1}st animal conference on development in Agriculture and biological sciences Federal University of Technology Akure, Nigeria. 27th, pp: 77-80.