ACCUMULATION OF LEAD, CADMIUM AND SULPHUR IN PASTURE GRASSES GROWING ALONG TRAFFIC HIGHWAY AND INDUSTRIAL LAYOUT IN SOUTH EASTERN NIGERIA

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ABSTRACT

Possible uptake of lead, cadmium and sulphur by ruminants from three pasture grasses, *Penisetum purpureum, Panicum repens and Cynodon dactylon* growing along traffic highway and industrial estates in Akwa Ibom State was investigated. Concentrations of the heavy metals and sulphur in the grasses were determined by atomic absorption spectroscopy and colorimetric methods respectively. *P. repens* from the traffic highway contained the highest amounts of lead (56.5μg g^{-1}) and sulphur (681 ppm dry weight) which were significantly ($P < 0.05$) higher than those from industrial layout (36.4μg - g^{-1}, Pb and 545 ppm sulphur respectively). The highest content of cadmium (1.6μg g^{-1}) was obtained from *P. repens* and *C. dactylon* from the same location of the traffic highway. The concentrations of the contaminants in all the grasses from industrial layout and traffic highway were higher ($P < 0.05$) than those from arable farm land and rural village which made up the control treatment. The results provide reliable information on the possible dangers ruminant animals are exposed to by grazing forages along traffic highways and around industries.

Key words: Lead, Cadmium and Sulphur, accumulation, Forage grasses.

INTRODUCTION

There is increased awareness that air pollution from urban and industrial areas may be contributing significantly to the load of heavy metals and sulphur in natural terrestrial ecosystem. Chisolm (1971) earlier identified various sources of lead contamination in the environment which include air-borne lead from automobile exhaust fumes from burning of leaded fuels, poorly maintained house with flaky lead-based paint and plaster, paint and battery factories and other industrial activities that involve lead.

Deposition of lead, cadmium and sulphur dioxide on the upper soil layers may induce higher contaminant levels in the above ground portion of pasture species that may in turn increase the load in herbivorous mammals feeding on them. The toxic effect of these contaminants is cummulative and long term exposure is hazardous (Anon, 1776). Young ruminants in Poland, Japan and Alaska respectively have been shown to ingest higher percentages of these contaminants than their adult counterparts (Sawicka - kapusta *et al.*, 1990; Noda *et al.*, 1995). Chmiel and Harrison (1981) reported that lead and cadmium levels in the bones of small ruminants living near highways reflect most reliably the load of heavy metals in the environment. Essien (1992) found that vegetables grown by the roadside also maintained high levels of lead. Thus possible heavy metals accumulation in forage species grazed by ruminants is of interest from environmental points of view. The pathological consequences of increased levels of heavy metals and sulphur dioxide deposited in the environment on ruminants bone tissue have been reported in Pennsylvania and Russia (Sileo and Beyer, 1985; Medvedev; 1995).

The aim of this study was to establish the concentrations of lead, cadmium and sulphur contamination of three pasture species *Penisetum purpureum* (Elephant grass), *Panicum repens* (Panicum), and *Cynodon dactylon* (Bermuda grass) from Uyo metropolis and some villages in Etim Ekpo L.G.A. in Akwa Ibom State, Nigeria. The latter was chosen as an almost unpolluted

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control area. The data may be suggestive of incidental lead, cadmium and sulphur consumption and their potential hazards on ruminants which indirecly affects man, the final consumer.

MATERIALS AND METHOD

The above-ground portion of the three forage species, Elephant grass, Panicum, and Bermuda grass at intermediate fully grown stage were randomly collected from pre-selected locations where cattle, sheep and goats are predominantly found foraging in Uyo environs and the chosen villages in Etim Ekpo Local Government Area.

The study locations were Uyo - Itu-Calabar highway (TH) with high traffic density; and industrial layout (IL) situated within Aka community at the outskirts of Uyo metropolis; arable farm land (FL) situated 500m away from the highway and from some fields and road side in Etim Ekpo L.G.A. rural vill ge (RV). Etim Ekpo L.G.A. is 30 km west of Uyo metropolis. After collection, the pasture grasses were kept in clean tightly sealed polythene bags properly labelled and taken to the central Research Laboratory, University of Uyo for analyses. The samples were dried to a constant weight in an oven preset at 60°C before grinding.

Lead and cadmium contents determinations were carried out by digesting 0.5g of each of the ground samples in a mixture of 60ml concentrated sulphuric: nitric acids. (1:1) according to the method of Pearson (1970). After slow heating to dryness, the residue was brought to the final volume of 100ml with double distilled water. These solutions were then analysed in an atomic absorption spectrophotometer (Perkin-Elmer 710 model, USA) with graphite furnace (HGA-76). The spectroscan standard solutions of metals were used for calibration.

Sulphur determination was estimated by colorimetric method. For this purpose, 0.2g of each dried ground pasture grass sample was digested in 50ml of concentrated nitric acid and heated for 15 mins and then a mixture of 60ml of perchloric acid and 30% hydrogen peroxide 1:1 were added. The resulting solution was brought to 100ml with distilled water. 4ml of the solution were poured into a test tube and brought up to 5ml with distlled water acidified with two drops of hydrochloric acid, before the addition of 1.5ml of saturated barium chloride. The optical density of the mixture was measured in a spectrophotometer. The sulphur concentration in the solution was determined using a calibration plot, based on the optical density of reference solution with a range of concentrations. The whole experimental procedure was replicated three times to establish the reproducibility of the extracts and the results obtained are presented as the mean of triplicate analyses. Statistical analyses were performed by two-way analyses of variance (Sokal and Rohlf, 1973).

RESULTS AND DISCUSSION

The concentrations of lead, cadmium and sulphur in the above-ground portion (leaf and stem) of the pasture species are presented in Table 1. The lead contents in *P. Purpureum, P. repens* and *C. dactylon* from traffic highway (53.6, 56.5 and 40.7$\mu g\text{-}g^{-1}$dry weight respectively) were significantly ($P<0.05$) higher than those from industrial layout (30.3, 36.4 and 27.2$\mu g\text{-}g^{-1}$ dry up respectively. Similarly lead concentrations in the pasture grasses from industrial layout were also higher than those from farm land. The least amounts of lead (5.8, 4.8 and 3.1 $\mu g\text{-}g^{-1}$) were respectively obtained from *P. Purpureum, P. repens* and *C. dactylon* growing in the rural village. They were much lower ($P<0.05$) than the levels obtained from all other locations. The concentrations of cadmium in all the grasses from industrial layout and traffic highway were statistically ($P=0.05$) the same but were significantly ($P<0.01$) higher than those from arable farm land and rural village (Table 1). Sulphur contents in *P. purpureum* (525ppm), *P. repens* (545ppm) and *C. dactylon* (488ppm) from industrial layout were statistically ($P=0.05$) the same. Also the sulphur levels in *P. repens* (581ppm) and in *P. purpureum* (502ppm) from traffic highway were significantly ($P<0.05$) higher than that in

C. dactylon (355ppm) from the same location. Generally, the amounts of sulphur in the pasture grasses growing along industrial layout and traffic highway were respectively higher ($P < 0.05$) than those from either the arable farmland or from the rural village.

The findings in this study have shown that automobile traffic on highway and industrial exhausts increased the deposition of lead, cadmium and sulphur concentrations on the surrounding vegetation. This result is further confirmed by the least values obtained from the control location (Etim Ekpo Village) and agrees with the finding of Smith (1976), Crump and Barlow (1982) working on pasture species, Singh *et al.*, (1983) during their pollution studies in Nigeria, and Essien (1992) working on leafy vegetables in Calabar.

The significant ($P < 0.05$) variations in the amounts of lead, cadmium and sulphur deposited in the pasture grasses from some locations as found in this study suggest possible dangers of industrial and automative exhaust waste in environmental pollution and contamination of crop and pasture plants. The high concentration of cadmium in *P. purpureum, P. repens* and *C. dactylon* from industrial layout and traffic highway than those from arable farm land and from the rural village can only be attributed to location and age of the plants. This assertion is in line with the findings of Scalon and Price (1976) and Crump and Barlow (1982) who reported that heavy metals accumulation in plant tissues increase linearly with age, the location of pollutants as well as the plant species. The significant ($P < 0.05$) differences in the levels of sulphur in *P. repens* from that in *C. dactylon* from traffic highway and those from the rural village suggest that different plant species from a particular location have different absorption and retention capacity for sulphur. The results are consistent with earlier reports that air borne lead from auto emissions and other sources tend to be concentrated in roadside dust, soil and shoots of crops and forage species found near major highways (Scalon & Price, 1976; Lau & Wong, 1982; Essien 1992).

TABLE 1: MEAN CONCENTRATIONS OF LEAD, CADMIUM ($\mu g\ g^{-1}$) AND SULPHUR (ppm/dry weight) IN THREE PASTURE GRASSES FROM FOUR LOCATIONS IN AKWA IBOM STATE.

Contaminants in Pasture Grasses	IL	TH	FL	RV
LEAD				
P. purpureum	30.3	53.6	15.1	5.8
P. repens	36.4	56.5	11.2	4.8
C. dactylon	27.2	40.7	10.2	3.1
Mean	31.3	50.3	12.2	4.6
S.E.M. (35 df)	2.15	3.18	1.42	0.51
LSD (0.05)	4.37	6.46	2.88	1.04
CADMIUM				
P. purpureum	1.6	1.4	0.6	0.05
P. repens	1.4	1.2	0,4	0.06
C. dactylon	1.2	1.1	0.3	0.03
Mean	1.4	1.2	0.4	0.05
S.E.M. (35 df)	0.16	0.30	0.02	0.003
LSD (0.01)	0.27	0.51	0.03	0.005
SULPHUR				
P. purpureum	526	502	256	58
P. repens	545	681	326	86
C. dactylon	488	355	247	38
Mean	519.7	512.7	277.0	60.7
S.E.M. (35df)	25.2	21.8	10.1	5.3
LSD (0.05)	51.16	44.25	20.50	10.76

IL = Industrial Layou; TH = Traffic Highway; FL = Farm Land; RV = Rural Village.

The significance of this finding is that animals grazing within high density traffic highways and industrial estates are exposed to higher intake of lead, cadmium and sulphur through these pasture grasses. This could lead to serious health problems in the animals. There may be the need to prevent cattle grazing along high density traffic roads and within industrial area. Further studies are worthwhile now that environmental lead, cadmium and sulphur pollutions have assumed international dimensions and most ruminants have been found to accumulate high levels of heavy metals and sulphur (Medvedev 1995; Noda *et. al;* 1995; Silvertsen *et al;* 1995 in North-West Russia, Alaska and Norwagian - Russia border areas respectively).

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