



Toxic Levels of Lead in Milk of Lactating Cows in Dareta Village Zamfara State

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ABSTRACT

Dareta village in Zamfara State, Nigeria is one of the worst affected by lead poisoning in the 2010 crisis in the State. This paper focuses on assessing the levels of heavy metals especially lead in milk of cattle grazing in this area after the post remediation exercise. Fresh milk was collected from lactating cows from different herds. The samples were digested and analyzed for presence of selected heavy metals using Atomic Absorption Spectroscopy method. Lead and Cadmium were detected in all samples analyzed with values ranging from 0.095 ± 0.005 - 0.309 ± 0.009 mg/L and 0.012 ± 0.001 - 0.017 ± 0.004 mg/L respectively. Values of the essential elements zinc, copper and iron fell within permissible limits in milk. In conclusion the high concentrations of lead and cadmium in milk samples analyzed indicate persistence of contaminating levels of Pb in the surrounding environment which constitute long term health risks to the local community.

Keywords: Mining, Lead toxicity, Milk.

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INTRODUCTION

By 2050, the world's population is estimated to rise to about 9 billion people that would need food and healthcare. With a rapidly expanding middle class especially in countries like China and India, a consequent change in dietary style would see an increase in the demand for more meat and dairy products (Godfray *et al.*, 2010; Wirsenius *et al.*, 2010)^{1,2}. Anthropogenic activities with direct impact on the environment and the competition for land and agricultural space pose a serious challenge on the quantity and quality of food targeted at the rising population (Pelletier *et al.*, 2010)³. In recent times anthropogenic activities in some districts in Zamfara State, Nigeria have impacted negatively on the ecology and livelihood of people living in these areas. Dareta village is one of several communities in Zamfara State, affected by heavy metal top soil contamination/pollution resulting from artisanal mining (WHO, 2010)⁴. Several investigations reported life threatening blood levels of heavy metals especially lead (Pb) (Getso *et al.*, 2013)⁵.

Children <5years are the worst hit age group; with 95% of recorded deaths in Yagalma and Dareta being children (Galadima and Garba, 2012)⁶. Mechanized methods of ore processing and indiscriminate disposal of Pb rich residual material increased further the routes of exposure to Pb poisoning (Plumlee *et al.*, 2013)⁷. Dust/airborne particles inhalation primarily exposes to direct heavy metal poisoning while farmlands and surface water pollution may be viewed as secondary risks factors not only to humans but livestock. Zamfara is well known for its farming activities and as a result, migrating pastoralists settle for many months to graze their livestock. A major economic activity of the women folk of these pastoralists is the selling of milk and butter in exchange for cereals and other crops.

Abdu and Yusuf, (2013)⁸ reported Pb related phytotoxicity could have come from dust deposition on the leaves and stalks of plants sampled in Abare, one of the villages affected by lead poisoning in the State. Similar trends of air borne heavy metal deposition were also reported in Dareta village rather than actual uptake and accumulation of the metals by plants (Udiba *et al.*, 2013)⁹.

Elsewhere, Ogundiran *et al.*, (2012) suggested rearing cattle around dump sites for Pb slag accounted for high levels of Pb in the blood and milk of lactating cows¹⁰. They found forage grass and leachate in these sites to contain significant levels of heavy metals. Lactating cows eliminate Pb in milk (Smirjakova, 2005)¹¹. The present study examines raw milk obtained from lactating cows grazing around Dareta village for possible contamination with Pb.

MATERIALS AND METHOD

Sample collection: Lactating cows (age of calf ≤ 1 year) were selected from 4 different herds (designated groups A, B, C and D) in the area under study. The cows were manually milked and 50mls of mid stream milk was collected directly into autoclaved graduated 100ml sample bottles. The bottles were carefully kept in ice packed canisters. Samples collected were transferred to the lab and refrigerated at 4°C. The cattle rarers were previously interviewed orally on their daily demographic routine.

Sample digestion and analysis

After wet digestion of samples as described by several authors¹², the method of Atomic Absorption Spectrometer (Model number AA240FS Varian) was used for heavy metal analysis and was carried out at the multipurpose laboratory, Faculty of Science, Ahmadu Bello University Zaria. Briefly, 3ml of conc. nitric acid was added to 1ml of milk, placed on a heating block in a fume cupboard until it boils. After allowing to cool, exactly 5ml of conc. HCl was added and then allowed to continue boiling until it reduces to 1/3 its initial volume. The digested sample was removed from the fume cupboard allowed to cool, filtered and made up to 100ml with deionized distilled water.

Statistical data analysis

Descriptive data obtained are presented as charts. Mean \pm SEM of analytes were calculated for each group while ANOVA was used to test for significance among groups using SPSS statistical tool (ver. 16).

RESULTS AND DISCUSSION

All samples (Figure 2) analyzed tested positive for the presence of Pb at concentrations above safe levels of 0.01mg/L (WHO, 2004)¹³. Figure 1 presents a description of the daily demographic activities of the cattle rarers. The rarers as indicated are permanently resident in Daret. The animals drink from surface water and milk is sold from all the cows except for the youngest group recorded with single parturition. Our findings may not be unconnected to high levels of heavy metals in soil around homes and farmlands even after post-remediation exercise (Udiba *et al.*, 2012)¹⁴. The topography of the study area encourages stagnation of surface water after heavy rainfall and re-birth of seasonal streams and their tributaries. These water bodies besides serving as water source for ore processing also serve as drinking spots for animals in search of food (Fig 1), and in our view, expose livestock to poisoning by leached metals.

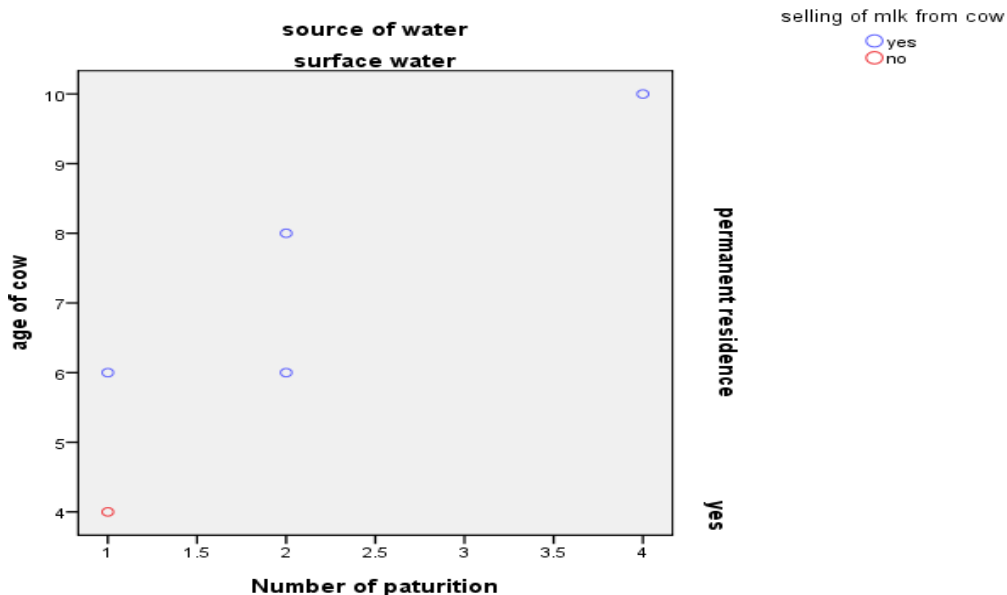


Figure 1: Demographic activity of herds selected for the study. Each spot (o) represent an average of >7 animals in each category

Levels of Pb and other heavy metals analyzed are presented in Figure 2. Pb as shown is present in all samples analyzed, with Group A having highest levels of Pb (0.309mg/L) and iron (Fe) (0.287mg/L). Concentrations of cadmium (Cd) is generally <0.02mg/L. The joint UNEP/OCHA (2010) report detected 198-605µg/L concentrations of lead in surface water samples in the area under study¹⁵. Since the herds are permanently resident (i.e. not migratory) in Daretta village, it is most probable the frequency of intake of contaminated feed and drinking water increases the tendency to accumulate Pb and other metals in tissues and milk secretions (Miranda *et al.*, 2009; Bala *et al.*, 2012)^{16,17}.

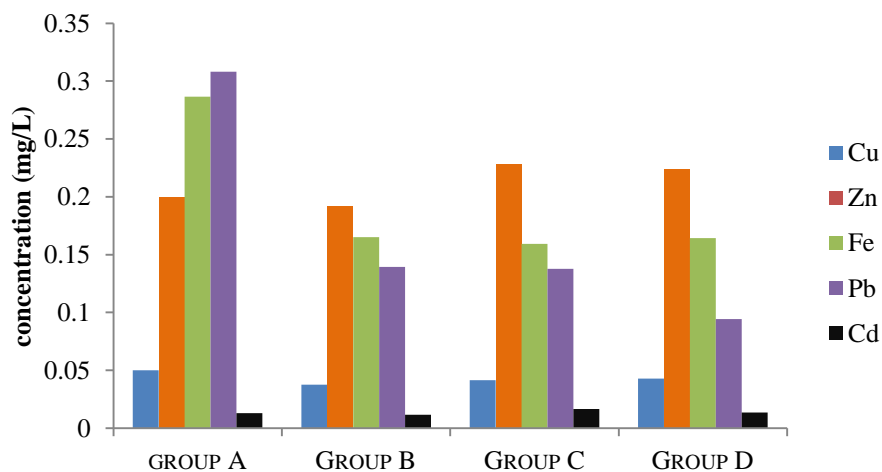


Figure 2: Concentration of heavy metals present in milk samples of cattle grazing around Daretta village.

The highest level of Pb recorded in group A animals significantly differ ($p < 0.05$) from the other groups (Table 1). Iron was also significant in group A but no statistical difference ($p < 0.05$) in the amounts of the other analytes present. Concentrations of Cu, Zn, and Cd did not differ significantly among the groups (Table 1) however, concentrations of Cd fell short of IDF permissible limits of 0.0026mg/L (Younus *et al.*, 2013)¹⁸. While acute exposures to toxic levels of Pb causes encephalopathy in children, chronic side effects include neurotoxicological cardiovascular and renal disorders (EFSA, 2010)¹⁹. Cd has a long biological half-life and cause kidney dysfunction and heart failure when accumulated in the body (Raikwar, *et al.*, 2008; EFSA, 2009)^{20,21}. Anthropogenic cause of food chain contamination is a growing concern globally. Milk and milk products are major sources of nutrients all over the world. Many reports have drawn attention to the health concerns of secondary route of exposure to unsafe levels of heavy metals in milk. Tona *et al.*, (2013)²² reported lower levels of Pb and Cd in raw cattle milk. Although lower levels of Pb and Cd were also reported by Gonzalez-Montana *et al.*, (2012)²³ animals reared in the vicinity of lead-zinc smelter had higher levels of these metals. A similar trend was also reported by Pavlovic *et al.*, (2004)²⁴ with Pb and Cd levels below 100µg/L and 10µg/L respectively. Higher concentrations of Pb and Cd in milk was reported by Iftikhar *et al.*, (2014)²⁵ for animals reared in urban areas while Ogundiran *et al.*, (2012) also reported higher Pb values in milk of cattle grazing in lead dump sites. Grazing animals or citing farms in areas where mining activities take place may cause health risks when such animals and/or their products are used as food.

Table 1: Comparison of heavy metals present in milk of cattle grazing in Dareta village

Groups	Analyte (mg/L)				
	Cu	Zn	Fe	Pb	Cd
A	0.050±0.009	0.200±0.016	0.287±0.041 ^a	0.309±0.099 ^a	0.013±0.003
B	0.038±0.004	0.192±0.013	0.166±0.008 ^b	0.140±0.021 ^b	0.012±0.001
C	0.042±0.002	0.229±0.017	0.160±0.020 ^b	0.138±0.032 ^b	0.017±0.004
D	0.043±0.002	0.224±0.021	0.165±0.022 ^b	0.095±0.005 ^b	0.014±0.001

Values are Mean± SEM of triplicate determinations. Different superscripts in same column are significant at $p < 0.05$.

CONCLUSION

The presence of Pb and Cd in milk samples from cattle grazing in Dareta village signifies toxic levels of these metals still persist in the environment. To the best of our knowledge, there are no reports on the assessment of Pb and Cd in milk in the area under study before or after the remediation exercise in 2010. As an emphasis, the long-term exposure especially to Pb by way of

contaminated milk consumption poses serious health risks to all age groups in this and surrounding villages in Zamfara State.

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