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Estimation of Lead and Cadmium Concentration in Dung Samples of Dairy Cows

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ABSTRACT: Presence of heavy metal in the environment has become a major hazard to human and animals as it is a persistent pollutant. Accumulation of toxic heavy metals contaminates the food chain and cause health threat to the consumers. A field research was conducted to estimate the level of toxic heavy metals present in dung samples of dairy cattle reared around industrial areas of Vellore, Tiruppur and Karur districts of Tamil Nadu. A total number of 96 samples were collected from dairy cattle to estimate the presence of toxic heavy metals such as lead (Pb) and cadmium (Cd) in dung samples. The highest mean lead concentration of 2.376 ± 0.461 ppm was recorded from dung samples of dairy cows in Karur district and all the samples were positive for lead in the study areas. However, the mean cadmium concentration (0.436±0.075 ppm) was highest in Tiruppur district. The percentage of total samples exceeded the mean value of dung was 29.17 per cent for lead and 22.92 per cent for cadmium.

Keywords: lead, cadmium, dung samples, cow.

INTRODUCTION

The toxic heavy metals coming from various industries like electroplating, automobile exhaustions and bicycle manufacturing industries entering the ecosystem may lead to geo accumulation, bioaccumulation and bio-magnification (Sherene, 2012). Industrial activities lead to possible transfer of heavy metals to cows from their rearing environment like water and plant, which can be accumulated and cause potential health risks to milk consumers (Yasotha *et al*., 2021). Lead being an abundant mineral with worldwide distribution pose threat to animal health and is accumulated in environment by industrial pollution (Patra *et al.*, 2006). Among the water sources surface water samples had greater pollution than groundwater (Carolene *et al.*, 2018) Higher level of cadmium on the plant leaves was attributed to the direct foliar deposition from agrochemicals and foliar absorption via atmospheric emission (Okunola *et al.*, 2008). Roofing materials of the dairy animal house influenced the physiological parameters of the dairy cow under different agroclimatic regions during summer (Sivakumar *et al.*, 2018) and South West Monsoon.

Though dairying in India has made rapid strides, animal productivity remained low due to the possible contamination of the land and water resources due to industrial pollution (Yasotha and Sivakumar, 2018a). Presence of these toxic metals may cause serious health issues in animals as well human beings while releasing to environment. Hence, a study was carried out to assess the presence of lead and cadmium in dung samples from dairy cows reared in and around industrial areas.

MATERIALS AND METHODS

In total 96 number of dung samples were collected from three industrial districts such as Vellore, Tiruppur and Karur. Sixteen number of dung samples from each district twice in a study period were collected from dairy cattle to estimate lead (Pb) and cadmium (Cd). About 200 g of dung samples were collected from the rectum after wearing hand gloves to avoid reaching the soil surface in a polythene bag twice with the interval of 6 months from the same animal. The collected dung samples were brought to the laboratory in a ice pack container for analysis. These samples were air dried followed by hot air oven drying at 60 ± 2°C until moisture were removed and ground to pass through < 2 mm mesh. The pre- processed dung samples were digested for lead and cadmium analysis as per the standard procedure. The digested samples were analysed for the presence of toxic metals *viz*. lead and cadmium using Inductively Coupled Plasma Mass Spectroscopy (ICP-MS) using an OPTIMA 2000 DV Spectrometer (Perkin Elmer Inc.). The heavy metal

concentrations in various samples were analyzed utilizing Statistical Package of Social Scientists 17 (SPSS 17)

RESULTS AND DISCUSSION

The concentration of lead and cadmium estimated from the dung samples collected from three districts are given in Table 1.

Lead concentration in dung samples of cows differed significantly ($p<0.001$) among the districts and the mean lead concentration of 1.179±0.223 ppm, 0.476±0.070 ppm and 2.376±0.461 ppm were recorded in Vellore, Tiruppur and Karur respectively. Among the districts, the highest mean lead concentration was recorded in Karur and all the samples were positive for lead in all the study areas. Lead was a widely distributed environmental pollutant in the dairy animal production system. It is exposed to the atmosphere through lead paint, lead batteries, automobile emissions, textile and phosphate fertilizer plant (Patra *et al.*, 2006). Textile and automobile industries were predominant in Karur district and the waste water discharged from industries were distributed to the agricultural land before being deposited in the sediment sinks. The discharged lead might have entered into animal system while grazing or feeding the fodder crops grown in those areas and eliminated through dung after digestion which concurs the findings of Yasotha and Sivakumar (2018b) who reported that analysis of feed samples will provide information on possible transmission of minerals from feed to faeces of the dairy cow reared in the industrial areas of Tamil Nadu in India.

Table 1: Lead and cadmium concentration (ppm) in dung samples collected from the selected districts of Tamil Nadu across the season (Mean ± SE).

Element	District	Dung	Minimum	Maximum	Mean value of present study (ppm)	Per cent of samples above mean value	F Value	p Value
Lead	Vellore	1.179±0.223[b]	0.110	2.540	**1.344**	43.75	10.383	0.000
	Tiruppur	0.476±0.070[b]	0.190	1.120		0		
	Karur	2.376±0.461[a]	0.510	6.920		43.75		
	Overall	**1.344±0.204**	**0.110**	**6.920**		**29.17**		
Cadmium	Vellore	0.038±0.006[b]	BDL	0.087	**0.170**	0	27.317	0.000
	Tiruppur	0.436±0.075[a]	BDL	0.910		68.75		
	Karur	0.036±0.009[b]	BDL	0.150		0		
	Overall	**0.170±0.037**	**BDL**	**0.910**		**22.92**		

Means bearing different superscripts in lower case in the same column, among different districts within respective element differ significantly (as per respective "p" value in the last column); overall is not included in statistical analysis; BDL indicates below detection limit; Detection limit is 0.01 ppm.

The minimum lead concentration (0.110 ppm) was recorded in Vellore district whereas the maximum lead concentration (6.920 ppm) was in Karur district. However, when the percentage of heavy metals put together over the calculated mean value per district, it was observed that both Vellore and Karur districts had same level of heavy metal concentration (43.75%) in dung samples whereas in Tiruppur district all the samples were within the calculated mean value since none of the samples exceeded the calculated mean values. There is the possibility of lead consumption by dairy cows while licking or ingesting discarded or used automobile batteries in and around the areas. This is in concurrence with the findings of Zadnik (2007) who reported that cattle were most commonly exposed to lead through ingestion of discarded automotive batteries, farm machinery grease or oil while grazing. Housed animals were restricted in consumption of hazardous substances in industrial areas and thatched housing is found to be the suitable one with respect to the climatic variables in North Eastern Zone of Tamil Nadu as stated by *Sivakumar et al.* (2017).

Significant ($p<0.001$) differences in cadmium concentration were found among the districts. It was highest in Tiruppur district (0.436±0.075 ppm) and the values ranged from BDL to 0.910 ppm. Whereas in Tiruppur and Karur the mean values were comparable to each other. However, when the percentage of heavy metals put together over the calculated mean value per district, it was observed that only Tirupur district had highest level of heavy metal concentration and showed 68.75 per cent of the dung samples exceeded the calculated mean value whereas in Vellore and Karur districts all the samples were within the calculated mean value. As Tiruppur is known for knitting units, dyeing units, bleaching units and electroplating (Karuppusamy, 2012), the release heavy metals particularly cadmium by electroplating industries may be the main reason for high cadmium content in Tiruppur compared to other districts studied. Dyeing industries in Tiruppur use numerous synthetic dyes and chemicals such as such as caustic soda, soda ash and heavy metals. Most of these chemicals are not retained in the finished hosiery goods, but are discharged as waste water.

These waste water is used for irrigation purpose and the dung produced by dairy cattle are used as manure by majority of the farmers in the study areas thus in turn reflect into agricultural system and eventually transferred to animals and excreted in dung as a cycle. Similar findings were reported by Chandran *et al.* (2012) who observed that the dung and urine produced by Red Purnia cattle under low input system were used as organic manure for their own agricultural land by farmers of Bihar.

While comparing the overall mean lead and cadmium concentration in all the districts, the lead (1.344±0.204 ppm) concentration was high than cadmium (0.170±0.037 ppm). The overall percentage of samples above calculated mean values were also high in lead (29.17 %) than cadmium (22.92 %).

CONCLUSION

Among the toxic metals studied, the highest mean lead concentration in dung sample of dairy cows was recorded in Karur district whereas, the highest mean cadmium concentration was recorded in Karur district. Furthermore, the highest mean concentration of lead in Karur was five times higher than the highest mean cadmium concentration in dung sample of dairy cows from Tiruppur. The study requires further analysis with more number of samples at periodical interval to arrive at concrete conclusion for carrying out the remedial measures.

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Conflict of Interest. None.

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