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Research Article

STATUS OF TOXIC HEAVY METALS IN CATTLE OF HARYANA

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ABSTRACT

Twenty five serum samples of cattle per district in different zones of Haryana were analyzed for the toxic heavy metals viz. Arsenic (As), Cadmium (Cd), Lead (Pb) and Mercury (Hg) using Atomic Absorption Spectrophotometer (AAS). Observed mean levels of As, Cd, Pb and Hg ranged from 0.0-0.087, 0.0-0.023, 0.0-0.115 and 0.0-0.23 ppm, respectively. The Cd content in serum of cattle of Panchkula district was found to be significantly ($p<0.05$) higher than all the other districts. Significantly ($p<0.05$) higher level of lead content was noted in Rohtak followed by Panchkula and Kurukshetra as compared to other districts of Haryana. Significantly higher mean value of Hg has been observed in Hisar, Kaithal, Karnal, Kurukshetra, Panchkula, Panipat, Rewari and Sonipat districts of Haryana. Zone wise analysis revealed the highest mean value of As, Cd, Pb, Hg in zone I (Panchkula, Ambala, Kurukshetra, Yamuna Nagar, Kaithal, Karnal, Panipat, Sonipat) in cattle.

Key words: AAS, Arsenic, Cadmium, Cattle, Heavy metals, Lead, Mercury

From an environmental point of view, all metals and semimetals that can be harmful are often classified as heavy metals. The metals of greatest concern due to their extensive use, their toxicity and their widespread distribution are Hg (mercury), Pb (lead), Cd (cadmium) and As (arsenic) (Baird and Cann, 2012). Food chain contamination by heavy metals has become a burning issue in recent years because of their potential accumulation in bio systems through contaminated water and soil. Farm animals, especially ruminants are very useful bio indicators of environmental pollution (FAO, 2014). It is presumed that concentration of arsenic in blood, hair, milk, or urine has been used as biomarkers of arsenic exposure in field animals (Mandal, 2017).

Therefore, it is necessary to monitor and assess the aggregate exposure to heavy metals concerning different environmental media and pathways to understand the relationships between the concentration of trace elements in soil, plants, water and animal system (Sharma *et al.*, 2007 and Ahmad *et al.*, 2013). The impacts of heavy metal toxicity on animals result in serious economic losses and economic consequences over and above health hazards. In India, heavy mortality in cattle and buffaloes due to industrial lead toxicity was responsible for decline in dairy animal population and significant financial losses to farmers (Swarup and Dwivedi, 1998). Hence, the present study was designed to assess the extent of exposure in cattle to heavy metals via drinking water, dietary intake from soil, water, plant and feed in the dairy cattle around the contaminated areas of Haryana.

MATERIALS AND METHODS

Sample collection: Twenty five serum samples per district (18 districts for this study) from Regional Research Centre on Foot and Mouth Disease, LUVAS, Hisar were obtained to assess the status of heavy metals viz. lead, cadmium, arsenic and mercury of cattle in different zones of Haryana. The samples were stored at -20°C immediately after collection for heavy metal analysis.

Heavy Metal Analysis: Di-acid (HNO_3 and $HCLO_4$ in ratio of 4:1) digested samples were analyzed for determination of arsenic, lead, cadmium and mercury concentrations using Atomic Absorption Spectrophotometer (AAS-Perkin Elmer) fitted with a specific lamp of particular metal using acetylene gas as fuel and air as an oxidizer as per the standard procedure outlined in the reference manual. Appropriate quality assurance procedure and precautions were carried out to ensure reliability of the results. Wavelength used for arsenic, cadmium, lead, and mercury is 193.70 nm, 228.80 nm, 283.31 nm and 253.65 nm, respectively.

Statistical Analysis of Data: The concentration of estimated heavy metals in various samples of different districts of Haryana state were analyzed by 't' test and one way ANOVA using SAS system.

RESULTS AND DISCUSSION

In this study (Table 1), mean levels of arsenic ranged from 0.0-0.087 ppm in cattle of Haryana. No significant difference ($p<0.05$) was observed between 18 districts. Cd level was found to be ranged between 0.0-0.023 ppm in cattle. The Cd content in Panchkula district was found to be significantly ($p<0.05$) higher than all other districts.

Range of mean level of Pb content was 0.0-0.115 ppm. Current study demonstrated significantly higher level of lead content in Rohtak followed by Panchkula and Kurukshetra as compared to other districts of Haryana.

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Table 1
Toxic heavy metals (ppm) content (Mean±SE) in serum samples of cattle indifferent districts of Haryana (n=25 for each dist.)

Sr. No.	Name of District	Arsenic	Cadmium	Lead	Mercury
1	Ambala	0.000 ± 0.000^{a}	0.010 ± 0.002^{ced}	0.000 ± 0.000^{d}	0.017 ± 0.006^{ab}
2	Bhiwani	0.000 ± 0.000^{a}	0.015 ± 0.002^{cb}	0.067 ± 0.024^{bc}	0.018 ± 0.011^{ab}
3	Fatehabad	0.000 ± 0.000^{a}	0.000 ± 0.000^{g}	0.020 ± 0.011^{d}	0.000 ± 0.000^{b}
4	Hisar	0.000 ± 0.000^{a}	0.007 ± 0.003^{ef}	0.011 ± 0.006^{d}	0.017 ± 0.006^{ab}
5	Jind	0.086 ± 0.051^{a}	0.002 ± 0.000^{fg}	0.000 ± 0.000^{d}	0.001 ± 0.001^{ab}
6	Kaithal	0.000 ± 0.000^{a}	0.002 ± 0.001^{fg}	0.000 ± 0.000^{d}	0.023 ± 0.013^{a}
7	Karnal	0.067 ± 0.027^{a}	$0.004 \pm 0.001e^{fg}$	0.076 ± 0.01^{abc}	0.010 ± 0.005^{ab}
8	Kurukshetra	0.053 ± 0.027^{a}	0.010 ± 0.002^{ced}	0.097 ± 0.029^{ab}	0.015 ± 0.006^{ab}
9	Mahendergarh	0.000 ± 0.000^{a}	0.009 ± 0.001^{ed}	0.000 ± 0.000^{d}	0.008 ± 0.004^{ab}
10	Mewat	0.063 ± 0.030^{a}	0.009 ± 0.002^{ced}	0.045 ± 0.012^{dc}	0.000 ± 0.000^{b}
11	Panchkula	0.066 ± 0.025^{a}	0.023 ± 0.002^{a}	0.109 ± 0.025^{ab}	0.016 ± 0.006^{ab}
12	Panipat	0.000 ± 0.000^{a}	0.014 ± 0.002^{cbd}	0.000 ± 0.000^{d}	0.016 ± 0.006^{ab}
13	Sirsa	0.062 ± 0.026^{a}	0.017 ± 0.002^{b}	0.000 ± 0.000^{d}	0.000 ± 0.000^{b}
14	Sonipat	0.063 ± 0.022^{a}	0.000 ± 0.000^{g}	0.000 ± 0.000^{d}	0.016 ± 0.005^{ab}
15	Yamuna Nagar	0.087 ± 0.036^{a}	0.006 ± 0.001^{efg}	0.000 ± 0.000^{d}	0.000 ± 0.000^{b}
16	Jhajjar	0.000 ± 0.000^{a}	0.000 ± 0.000^{g}	0.000 ± 0.000^{d}	0.006 ± 0.002^{ab}
17	Rewari	0.000 ± 0.000^{a}	0.000 ± 0.000^{g}	0.000 ± 0.000^{d}	0.016 ± 0.005^{ab}
18	Rohtak	0.058 ± 0.023^{a}	0.006 ± 0.001^{efg}	0.115 ± 0.028^{a}	0.000 ± 0.000^{b}

Means with same superscript within column don't differ significantly at P=0.05.

Range of mean serum level of Hg was reported as 0.0-0.23 ppm. In some districts (Fatehbad, Mewat, Sirsa, Yamuna Nagar, and Rohtak), level of Hg was below the detectable level. Significantly ($p<0.05$) higher mean value of Hg has been observed in Hisar, Kaithal, Karnal, Panipat, Sonipat, Rewari, Panchkula and Kurukshetra districts of Haryana.

Zone wise comparison of heavy metals contents in serum samples of cattle of Haryana

The state is divided into 3 agro-ecological zones: Zone-1 (Panchkula, Ambala, Kurukshetra, Yamunanagar, Karnal, Kaithal, Panipat and Sonipat), Zone-2 (Sirsa, Fatehabad, Hisar, Jind, Rohtak, Faridabad and Palwal) and Zone-3 (Bhiwani, Mahendergarh, Rewari, Jhajjar, Gurgaon and Mewat). Zone wise comparison of heavy metals content in serum of cattle revealed no significant difference ($p<0.05$) in the mean level of As, Cd and Pb, whereas Hg content of zone II cattle was found to be significantly lower as compare to zone I and III (Table 2). Mean value of Pb, Hg, Cd and As were found to be higher in zone I cattle. It could be due to industrialization of the region. There has been tremendous growth of industries in the towns like Faridabad, Gurgaon, Panipat, Sonepat, and Yamuna Nagar during last 5-6 years (MSME, 2016). Among all the four heavy metals, mean cadmium level was found to be lowest in all the zones.

Evaluation of heavy metals level in livestock is important for assessing the potential effects of pollutants on grazing cattle and buffalo and for quantifying contaminant intakes by humans. Heavy metals are responsible for causing various diseases which is devastating and economically important disease of cattle and buffalo. In India, the disease has caused huge economic losses to the livestock (Rajaganapathy *et al.*, 2011). Dwivedi *et al.* (2001) reported that the blood lead level in cattle was considerably higher in urban areas than those reared in rural parts. Intake of lead contaminated forages could be the contributing factor for this condition. Gowda *et al.* (2003) compared the levels of metals in the plasma of dairy animals reared in Peenya industrial town in the peri-urban region of Bangalore city and reported comparatively higher Pb (0.09 ± 0.03 ppm) and Cd (0.065 ± 0.014 ppm) than Cu and Zn which were normal.

Lead toxicity was reported in bovine in an industrial area in Punjab by Sidhu *et al.* (1994). Blood Pb concentration ranged from 19.5 to 73.1 ppm in ruminants. The Pb content in erythrocytes varied from 23.4 to 42.9 ppm. Normal blood Pb level in ruminants is 5 to 22.5 μg/100 ml. Dwivedi *et al.* (2001) recorded varying degrees of Pb poisoning in cows and buffaloes near a primary Lead-Zinc smelter in India. Blood level of 1.43 ppm Pb and 0.11 ppm Cd was detected in the vicinity of the smelter.

Tomza-Marciniak *et al.* (2011) estimated the serum concentration of cadmium, lead, iron, zinc, copper, chromium, nickel, aluminum and arsenic in cattle from organic and conventional farms. The results revealed significantly lower serum concentration of heavy metals except cadmium in animals of organic farm than conventional farm. Swarup *et al.* (1997) estimated the lead

Table 2
Zone wise comparison of heavy metals (ppm) contents (Mean± SE) in serum samples of cattle of Haryana

Element	Zone I (n=200)	Zone II (n=125)	Zone III (n=125)
Arsenic	0.042 ± 0.008^{a}	0.040 ± 0.013^{a}	0.017 ± 0.0080^{a}
Cadmium	0.009 ± 0.001^{a}	0.0065 ± 0.00^{a}	0.009 ± 0.0010^{a}
Lead	0.035 ± 0.006^{a}	0.025 ± 0.007^{a}	0.030 ± 0.0067^{a}
Mercury	0.014 ± 0.002^{a}	0.004 ± 0.001^{b}	0.010 ± 0.003^{ab}

Zone I: Panchkula, Ambala, Kurukshetra, Yamuna Nagar, Kaithal, Karnal, Panipat, Sonipat; Zone II: Sirsa, Fatehabad, Hisar, Jind, Rohtak
Zone III: Bhiwani, Mahendergarh, Mewat, Jhajjar, Rewari
Means with same superscript (within row) don't differ significantly at P=0.05.

and cadmium levels in blood of cows from Kanpur city and observed significantly higher concentration of lead and cadmium in the cows of urban locality than those of rural areas. Ahmad *et al.* (2017) reported high concentration of noxious heavy metals including Cu (0.223 ± 0.010 mg/kg) and Cd (0.117 ± 0.086 mg/kg) in the milk of buffalo.

Somasundaram *et al.* (2005) recorded higher Pb, Cd, Cu serum concentration in Jersey crossbred cattle in Coimbatore, India. High amount of heavy metals was reported in serum samples in animals consuming fodder grown in land irrigated by polluted water with a mean concentration of Cd, Pb, Cu, Cr, Ni, Co, Zn, Fe and Mn as 0.022, 0.385, 0.302, 0.140, 0.029, 0.077, 0.496, 24.16 and 0.04 ppm, respectively (Raj *et al.*, 2006). The blood level of Pb range from 0.21- 10.6 mg/ kg and Cd level range from 0.004-0.02 mg/kg. Cd level observed was in safe limit. Lead up to level of 0.25 µg/ml in blood is considered to be safe, above 0.35 µg/ml is toxic and 1 µg/ml is fatal for ruminants (Swarup *et al.*, 2006).

In the presents study, results are comparable with the past studies reported by different researchers and mostly the observed levels are within the permissible limits (Suttle, 2010). However, this is the preliminary study; further work may be carried out by estimating the level in more number of samples.

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