

STUDY ON LEAD LEVEL IN BLOOD AND TISSUE SAMPLES OF BUFFALOES

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ABSTRACT

A study was conducted to find the levels of lead in the blood, serum, liver and kidney of buffaloes and to assess the level of lead toxicity. For this, 14 samples of blood and serum from buffaloes reared at different industrial and rural areas of Jabalpur and 11 samples of liver and kidney tissues from buffaloes found dead during the study period in the same area, were collected, irrespective of age and sex and were analyzed for lead level estimation and for detailed histopathology. The samples were acid digested in a microwave digester and analyzed in Atomic Absorption Spectrophotometer for lead level estimation. One out of 14 animals showed lead level of more than 1 ppm in blood and serum which was highly toxic, while 86 percent of the samples had lead levels in the mild toxic range of 0.35 to 0.8 ppm.

Keywords: *Bubalus bubalis*, buffaloes, lead, blood, serum, tissue

INTRODUCTION

Riverine buffaloes (*Bubalus bubalis*), valued for milk, meat, draught power and efficient

converters of low-quality feeds, are the preferred livestock in India. The world buffalo population is estimated at 185.29 million, spread in some 42 countries, of which 179.75 million (97%) are in Asia and India has 105.1 millions and they comprise approximately 56.7% of the total world buffalo population (FAO, 2008).

Lead is a known toxic metal, found naturally in the earth's crust recently consequences to modernization and industrialization increased its load in the atmosphere, soil, fodder and water. (Lemos and Driemer, 2004; WHO, 2010). Domestic animals especially the dairy cattle and buffaloes are considered as most susceptible to lead toxicity. Lead levels in the blood may act as a valuable indicator of lead-contaminated environment. Whole blood levels of lead in normal ruminants are usually below 0.05 to 0.25 mg/kg; poisoned animals usually have levels above 0.35 mg/kg and deaths begin at 1 mg/kg (Dey *et al.*, 1996). Jabalpur region of Madhya Pradesh have various industries like Gun carriage factory and ordinance factory which uses lead as the raw material and studies have indicated an increased lead contamination in water (Singh *et al.*, 2013).

Dairying is a major income generating occupation in this region with buffaloes contributing the bulk of it. Lead, with its potential

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milk excretion and cumulative toxic nature, is a threat to both animals and humans. So the present study was planned to investigate the exposure of lead and the pathological changes caused by the exposure of lead in buffaloes of Jabalpur.

MATERIALS AND METHODS

For estimation of lead in blood and serum of buffaloes, those that are reared in different polluted/ industrial area were selected for analysis. A total of 14 blood and serum samples and 11 liver and kidney tissue samples were collected from buffalo randomly from different regions of Jabalpur. 10 ml of blood was collected aseptically from the jugular vein of bovines which were reared near the high ways as well as various industrial and urban areas and areas identified with high lead content in water bodies. Liver and kidney tissue samples were collected from post mortem cases. The samples were subjected for acid digestion, by adding concentrated nitric acid and 30% hydrogen peroxide.

The mixture was then digested in a microwave digester (ETHOS UP) for 45 minutes for blood and serum and 50 minutes for tissue samples. The digested samples were stored at -20°C till analysis and lead estimation was done by Atomic Absorption Spectrophotometer (LAB INDIA; AA 8000). The tissue samples were also collected for histopathology.

RESULTS AND DISCUSSION

Lead level in blood and serum

In the present study it was found that all the samples which were examined showed

the presence of lead levels above the maximum permissible limit given by WHO, with mean values of 0.65 ppm in blood, 0.79 ppm in serum, 0.9 ppm in liver and 0.86 ppm in kidneys. The lead level observed in the blood and serum of 14 buffaloes examined is given in the Table 1. The values ranged from 0.315 to 1.04 ppm in blood and 0.385 to 1.056 ppm in serum. Only one animal out of 14 animals had lead level higher than 1 ppm. Swarup *et al.* (1993) recorded the mean blood lead level of 0.58 ppm in buffaloes from the industrial areas of Ghaziabad and cows from urban areas of Delhi. Dey *et al.* (1996) recorded the mean blood lead concentration of 1.51 ± 0.25 and 0.33 ± 0.04 ppm in buffaloes from the polluted and rural areas, respectively.

Lead level in liver and kidney

The lead level observed in the liver and kidney tissues of 11 buffaloes which were subjected for detailed post mortem examination are given in the Table 2. The values ranged from 0.069 to 1.174 ppm in liver and 0.052 to 1.254 ppm in kidneys.

In the present study a good correlation between the level of lead in liver and kidney in bovines amidst a slight increased level in liver were recorded. Waegeneers *et al.* (2009) found 1.8, 2.2 and 2.5 fold higher lead concentrations in kidneys and 2.3 fold higher concentrations in liver of bovines from the contaminated areas and Bala *et al.* (2013) reported high concentration of lead in liver tissue as compared to kidney tissues.

Average lead concentration of liver and kidney were higher than non toxic limit of 0.1 to 1 ppm according to Puls (1994). In line with our results, high lead level in liver and kidney of bovines were reported by various scientists. Dogra *et al.* (1996) noted toxic levels of lead in the liver and kidney of naturally poisoned cases of cattle.

Table 1. Lead level in the blood and serum of buffaloes (ppm).

Animal no	Lead level in blood (ppm)	Lead level in serum (ppm)
1	0.639	0.773
2	0.639	0.984
3	0.612	0.987
4	0.652	0.88
5	1.04	1.056
6	0.693	0.906
7	0.666	0.88
8	0.71	0.853
9	0.586	0.639
10	0.746	0.831
11	0.315	0.385
12	0.436	0.443
13	0.639	0.742
14	0.666	0.759
Mean±SE	0.65±0.04	0.79±0.05

Out of the 14 animals, 12 animals had lead levels in blood in the mild toxic range of 0.35 to 0.8 ppm.

Table 2. Lead level in the liver and kidney tissues of buffaloes (ppm).

Animal no	Lead level in liver (ppm)	Lead level in kidney (ppm)
1	0.077	0.052
2	0.069	0.077
3	1.013	1.147
4	1.12	1.094
5	0.96	1.067
6	1.12	0.479
7	1.147	1.094
8	1.174	1.094
9	1.12	1.094
10	1.094	1.254
11	1.04	1.04
Mean±SE	0.90±0.13	0.86±0.13

The observed mean lead levels in the liver and kidney tissues of 11 buffaloes, 8 buffaloes showed >1 ppm and 3 had 0 to 1 ppm.

Checkley *et al.* (2002) reported lead concentrations of 8.92 and 6.35 ppm in the liver of calves found dead due to lead poisoning. Korenekova *et al.* (2002) reported the mean lead levels of 1.07 ppm in liver of bovines reared near metallurgic industry.

Pathological changes

Buffaloes which have showed high lead concentration in liver and kidney tissue showed the degenerative, inflammatory and vascular changes in the liver and kidney tissue of buffaloes. In liver, lesions like congestion, pale discoloration, multiple necrotic foci, hepatomegaly with fibrosis and nodules were noted. Kidneys were congested, hemorrhagic, mottled and contracted, besides showing necrosis and infarction. Necrosis, inflammatory changes and bile duct hyperplasia were prominent in bovine liver having toxic lead concentration >5 ppm, whereas focal atrophy, sclerosis, fibrosis, nephritis, basophilic tubules and tubular hyperplasia were recorded in kidneys with toxic lead concentration >5 ppm.

Gholami *et al.* (2004) documented the slight enlargement and grey discoloration of liver and kidney and microscopically mild periportal fibrosis, congestion, fatty degeneration, bile duct hyperplasia and severe degenerative changes in lead exposed liver while in kidneys proximal tubules were mainly affected and showed degeneration and necrosis along with encroachment of the tubular lumen in bovines affected with lead toxicity. Missoun *et al.* (2010) reported the contracted and granular kidney with loss of cortical tissue in wistar rats which received 1000 ppm of lead acetate at sub-acute exposure. Suradkar *et al.* (2010) reported the enlarged, pale and friable liver in wistar rats treated with lead acetate upto 1,000 ppm.

Results of the present study suggest that the bovines of Jabalpur had substantial exposure

to lead levels higher than the minimal toxic dose of lead in blood i.e. 0.35 ppm.

The high blood lead concentration is an alarming situation indicating towards a chronic lead toxicosis, which can affect the health, fertility, production and even the survivability of the animals (Dogra *et al.*, 1996; Checkley *et al.*, 2002; Aslani *et al.*, 2012). Lead toxicity is also a public health cause of concern as lead is being excreted through the milk (Swarup *et al.*, 2005; Bischoff *et al.*, 2014) and can adversely affect the health of calves as well as human children.

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