

Research Article

Lead Residues in Different Animal Tissues at Selected Areas of Chittoor District of Andhra Pradesh, India

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Abstract

The present study was aimed to know the concentrations of lead in different tissues of cattle and sheep found in different localities of Chittoor district of Andhra Pradesh, India. From cattle and sheep, a total of 120 samples and 80 samples of liver, kidney, muscle and testis were collected from different selected areas in Chittoor, Tirupati and Renigunta. These samples were subjected to acid digestion method and estimated lead concentration by following atomic absorption spectrophotometer. The highest concentration of lead was observed in kidneys (1.00 mg/kg) followed liver (0.6 mg/kg) and muscle (0.5 mg/kg) of cattle reared in and around Renigunta when compared to other areas. The samples of sheep collected from two different urban areas revealed highest lead content in kidneys (0.23 mg/kg) followed by liver (0.10 mg/kg) muscle (0.09 mg/kg) and testis (0.02 mg/kg) of sheep samples which were collected from Chittoor urban area when compared to the samples of Tirupati Urban area. The lead concentration was high in different tissue samples (Kidney, liver, muscle) of cattle when compared to sheep tissue samples.

Keywords: Lead residues; Atomic absorption spectrophotometer; Cattle; Sheep; Tissues; Polluted areas

Introduction

Metal intoxication is one of the most frequent diseases in farm animals, particularly in those grazed on pasture in the vicinity of metallurgic/other industrial complexes, mining communities and busy roads. Grazing animals are directly affected by the consumption of forage and feed contaminated by airborne lead and somewhat indirectly by the up-take of lead or other metals through plant roots. The risk of metal poisoning through the food chain increases as the soil metal level rises above the permissible concentration for a given metal [1,2]. This implies that grazing animals are more at risk as forage grasses are consumed directly without being washed.

Lead is the most important poison to the farm animals. For farm animals significant pollution is likely to occur from lead mining, painted and metallic lead in storage batteries, licking paints/puttyans from rubbish dumps. Areas near lead industrial establishments may be enriched by aerial deposition as a consequence; soil pollution as well as quality deterioration of edible portions of vegetation can be produced due to metal enrichment. Animals by eating this vegetation can accumulate enough lead to produce clinical signs of lead poisoning. Young animals are usually poisoned when they lick painted pens, troughs etc because of allatrophagia. Chronic lead poisoning commonly seen in young children from sucking lead paint or lead toys, in workers engaged in painting and petroleum industries.

Lead is a metabolic poison and a neurotoxin that binds to essential enzymes and several other cellular components and inactivates them [3]. Toxic effects of lead are seen in haemopoietic, nervous, gastrointestinal and renal systems [4]. It interferes with a variety of body processes and is toxic to many organs and tissues including the heart, bones, intestines, kidneys, reproductive and nervous systems. It

interferes with the development of the nervous system and is therefore particularly toxic to children, causing potentially permanent learning and behavior disorders [5].

The aim of the present study was to evaluate the concentrations of lead in liver, kidney, muscle and testis of cattle and sheep which are liable to contamination by lead. Also the investigation provided information about the concentration of lead in different selected areas in Chittoor district of Andhra Pradesh.

Materials and Methods

For estimation of lead residues in animal tissues, those that are reared in different polluted areas were selected for tissue residual analysis.

From cattle a total of 120 samples of liver, kidney, muscle and testis were collected from different areas in Chittoor (polluted area i.e. in and around Nutrine & Sugar factory), Tirupati (polluted Battery factory area) and Renigunta (polluted & heavy traffic area and nearby Railway station). Tissues were also collected from sheep a total of 80 samples which represent four organs (liver, kidney, muscle & testis) from Chittoor (polluted & factories area) and Tirupati (polluted area). The samples were collected randomly, irrespective of age, sex and breed. All the samples in cattle and sheep were packed separately and stored at -20°C until analysis.

The tissue samples of cattle and sheep were subjected to acid digestion method [6], then these samples were used for lead residual estimation by following the method of Perkin-Elmer 3100 (USA) double-beam atomic absorption spectrophotometer with hallow cathode lamp of lead.

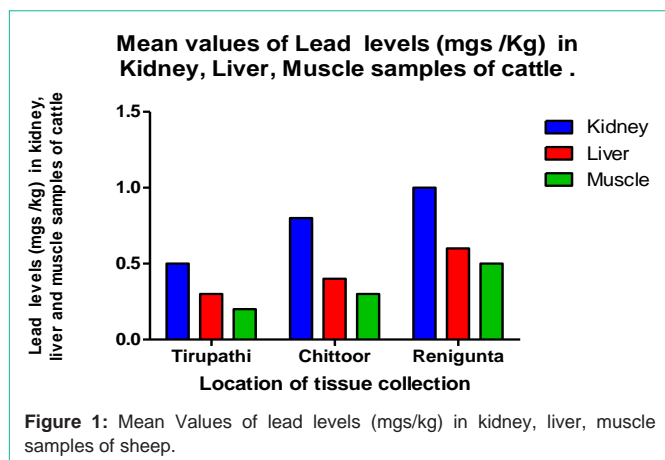


Figure 1: Mean Values of lead levels (mgs/kg) in kidney, liver, muscle samples of sheep.

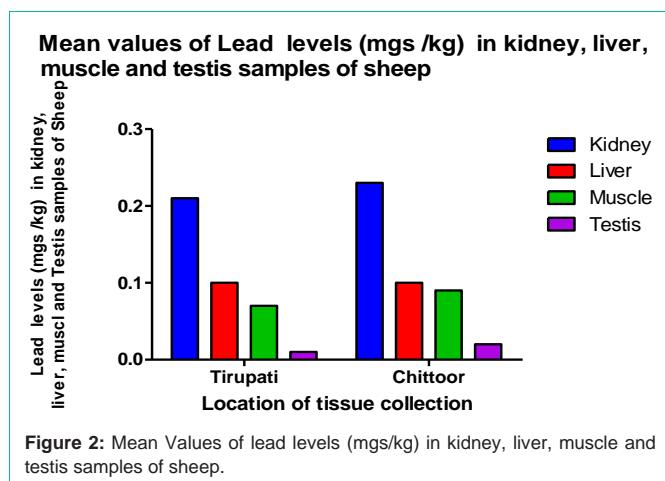


Figure 2: Mean Values of lead levels (mgs/kg) in kidney, liver, muscle and testis samples of sheep.

Results

Tissue lead content in cattle

The mean concentrations of lead in analyzed samples of cattle kidney, liver and muscle which were collected from urban and heavy traffic areas such as Tirupathi, Chittoor and Renigunta and the values are 0.50, 0.80 and 1.00 (Kidney), 0.30, 0.40 and 0.60 (Liver) and 0.20, 0.30 and 0.50 (muscle) mg/kg respectively and was shown in Table 1 and Figure 1. The levels of lead varied according to the locality and organ, among the tissues the highest concentrations of lead were detected in kidney followed by liver and muscle samples of cattle that lived in and around Renigunta when compared to other mentioned areas (Tirupathi and Chittoor).

Tissue lead content in sheep

The data pertaining to the pooled tissue lead content in sheep was displayed in Table 2 and Figure 2 and the values of lead in pooled kidney, liver, muscle and testis of sheep that lived at Tirupathi and Chittoor were 0.21 and 0.23, 0.10 and 0.10, 0.07 and 0.09, 0.01 and 0.02 (mg/kg) respectively. The highest concentration of lead was noticed in kidney followed by liver, muscle and testis of sheep that lived at Chittoor when compared to Tirupathi area. Whereas no significant difference was found in liver lead level of sheep that reared in both areas.

Table 1: Lead levels (mg /kg) in kidney, liver and muscle samples of cattle from different regions (mgs/kg).

Locality	Kidney	Liver	Muscle
Tirupathi	0.5±0.029	0.03±0.012 ^a	0.2±0.025 ^{ab}
Chittoor	0.8±0.23	0.4±0.34 ^a	0.3±0.25 ^a
Renigunta	1±0.03	0.6±0.04 ^a	0.50±0.5 ^a

Mean values with different superscripts differ significantly ($P < 0.05$); ANOVA; SE: Standard Error.

Table 2: Mean values of Lead levels (mgs/kg) in kidney, liver, muscle and testis samples of sheep (mgs/kg).

Localities	Kidney	Liver	Muscle	Testis
Tirupathi	0.21±0.015	0.10±0.0089 ^a	0.07±0.0025 ^a	0.01±0.0012 ^{abc}
Chittoor	0.23±0.010	0.10±0.009 ^a	0.09±0.002 ^a	0.02±0.0032 ^{abc}

Mean values with different superscripts differ significantly ($P < 0.05$); ANOVA; SE: Standard Error.

Discussion

The highest concentration of lead was observed in kidneys (1.00 ppm) followed liver (0.6 ppm) and muscle (0.5 ppm) of cattle reared in and around Renigunta when compared to other areas like Chittoor and Tirupathi. Abou Donia [7] noticed highest concentration in kidney (0.59±0.790 mg/kg), Liver (0.510 & 0.623 mg/kg) and muscle (0.09 mg/kg). Mariam et al. [8] reported mean lead concentration of 2.18±0.38 ppm and 2.02±0.44 ppm for livers and kidneys respectively of beef in Lahore. The results indicates that the concentration of lead in the livers and kidneys were less than permissible limit of 1 ppm [9].

In present study the samples of sheep collected from two different urban areas revealed highest lead content in kidneys (0.23 mg/kg) followed by liver (0.10 mgs/kg) muscle (0.09 mg/kg) and testis (0.02 mgs/kg). The highest concentration of lead was noticed in sheep samples collected from Chittoor urban area when compared to the samples of Tirupathi Urban area. The values recorded in this study were lower than maximum permissible level of 1 ppm and the least concentration was noticed in testis of sheep. In contrary to the present findings Gervos et al. [10] reported higher concentration of lead in liver (0.85 mg/kg) followed by kidney (0.36 mg/kg) and meat (0.04 mg/kg).

The lead concentration was high in different tissue samples (Kidney, liver, muscle) of cattle when compared to sheep tissue samples. Coni et al. [11] determined the levels of lead in the specific organs of cow, sheep and goat and found that liver and kidney of cows had higher levels of lead than the liver and kidney of sheep and goat. The lower lead levels in sheep might be due to slaughtering at early age and generally sheep will be maintained in far away from urban area hence exposure to less pollution. No reports available to compare this.

Conclusion

Cattle and other animals serve as bio-indicators of environmental contamination with heavy metals. The presence of lead in the tested samples of animal tissues serves as an indication that the environment where these animals grazed before they were purchased for slaughtering was contaminated with lead. Consumption of meat of these animals may pose a serious health problem to man especially children <5 years old as a result of bioaccumulation of lead in the

body tissues. This however varies among individuals and depends on duration of exposure.

References

1. Singer MJ, Hanson L. Soil Science Society of America Proceedings. 1969; 33: 152-153.
2. Rolfe GL, A Haney, Reinbold KA. Ecosystem Analysis. Institute for Environmental Studies. University of Illinois, Urbana-Champaign. 1977; 112.
3. Cunningham, Saigo. Environmental Science a Global concern, 4th edition WMC Brown Publisher, New York. 1997; 389.
4. Baykov BD, Stoyanov MP, Gugova ML. Cadmium and Lead bioaccumulation in male chickens for high food concentration. Toxicology Environmental Chemistry. 1996; 54: 155-159.
5. Venkatesh T, Shambhavi T. Treating Lead Toxicity: Possibilities beyond Synthetic Chelation. JKIMSU. 2013; 2: 4-31.
6. Kolmer JA, Spaulding EH, Robinson HW. Approved lab technique, 5th edition, Appleton century- crofts. Inc. Newyork. 1951; 1090-1091.
7. Abou Donia MA. Lead concentrations on different animals muscles and consumable organs at specific localities in Cairo. Global Veterinaria. 2008; 2: 280-284.
8. Mariam I, IQbal S, Nagra SA. Distribution of some trace and Macrominerals in beef, mutton and poultry. International Journal of Agricultural and Biology. 2004; 5: 816-820.
9. Iwegbue CMA. Heavy metal composition of livers and kidneys of cattle from Southern Nigeria. Veterinary Archives. 2008; 78: 401-410.
10. Gervos Hans, Lammers Wount, Van Delft. Arsenic, Cadmium, lead and mercury in meat, livers and kidneys of sheep slaughtered in the Netherlands. Zeitschrift Fur lebensmittelunter suchung and forschung A. 1998; 187: 1-7.
11. Coni E, Bocca A, Coppolelli P, Corolis C, Cavallucci M, Marinucci T. Minor and trace element content in sheep and goat milk and dairy products. Food Chemistry. 1996; 17: 253-260.