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Assessment of Pb and Cd in chicken livers and eggs by ICP-OES

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ABSTRACT

Contamination of food with toxic heavy metals is a serious threat because they are non-degradable, have long biological half life and with a potential of bioaccumulation in different organs and biomagnification. Hence, the present study was undertaken to estimate the levels of lead and cadmium in chicken liver and egg samples. Out of 53 liver samples examined for presence of lead and cadmium, only 31(57.41%) samples were positive for lead and 35 (64.81%) samples were shown cadmium where as Pb and Cd was not detected in all 26 egg samples. The maximum concentrations of lead and cadmium in chicken liver samples are 0.009ppm and 0.006ppm and minimum concentration is zero for both. However, the heavy metals levels are within the safe limit and are not significant. But still, there should be continuous monitoring and surveillance to prevent bioaccumulation of heavy metals in future.

Keywords: Pb, Cd, Chickens Liver, ICP-OES, Heavey Metals

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INTRODUCTION

Though the heavy metals in lower concentration are very much essential to maintain various biological and physiological functions in living organisms but they become toxic to organisms when they cross normal threshold concentration [18]. Although there is awareness about the harmful effects of heavy metals which lasts for longer period; but still the exposure to heavy metals is increasing day by day in different parts of world [18].

Heavy metals are highly considered environmental pollutants as their toxicity is a serious problem towards ecological, evolutionary, nutritional and environmental aspects. Either by natural means or through human activities, these heavy metals enter the surroundings. Soil erosion, natural weathering of earth's crust, mining, industrial effluents, urban runoff, sewage discharge, insect or disease control agents applied to crops are some of the sources of heavy metals by which they enter into surroundings [19].

Now-a-days, food safety is a major public health concern worldwide. Most of the heavy metals are used as trace elements and feed additives in poultry feed**.** Major research regarding food safety is to assess the risks associated with consumption of food stuffs contaminated by pesticides, heavy metals and/or toxins [2].

Lead is a highly toxic element and its widespread, causes environmental contamination and many health problems in different places of world [18]. The various sources of lead exposure are industrial processes, food and smoking, drinking water, domestic sources, gasoline, house paint, lead bullets, plumbing pipes,

pewer pitchers, storage batteries, toys and faucets [18]. Human exposure of lead in general population is either due to food or drinking water as lead may taken up by plants, fixation to soil and flow into water bodies [7].

Based on several epidemiological and animal experimental works suggested that inorganic lead compounds are associated with increasing risks of tumour occurrences. According to IARC evaluations, lead is categorized under group-3 i.e. non classifiable as to its carcinogenicity to humans.

Table1. ARC evaluations made of the carcinogenicity of trace elements and related compounds to humans by the international agency of research on cancer (IARC 1993)

Group 1: carcinogenic to humans		Group 2A: probably carcinogenic		Group 2B: possibly carcinogenic		Group 3: not classifiable	
Trace element	Chemical group	Trace element	Chemical group	Trace element	Chemical group	Trace element	Chemical group
As	Arsenic and its compounds	Pl	Cisplatin	Sb	Antimony trioxide	Sb	Antimony trisulfide
Be	Beryllium and its compounds	–	–	Co	Cobalt and its compounds	Cr	Metallic and trivalent chromium compounds
Cd	Cadmium and its compounds	–	–	Pb	Inorganic lead compounds	Fl	Inorganic fluorides
Cr	Hexavalent chromium compounds	–	–	Ni	Metallic nickel	Fe	Ferric oxide and hematite
Ni	Nickel compounds	–	–	–	–	Pb	Organic lead compounds
–	–	–	–	–	–	Hg	Metallic and inorganic mercury compounds
–	–	–	–	–	–	Se	Selenium and its compounds
–	–	–	–	–	–	Ti	Titanium dioxide

Cadmium, the seventh most toxic heavy metal as per ATSDR ranking [18] is a widespread environmental and industrial pollutants. It is naturally present in air, soil, sediments and also in unpolluted sea water [23]. Cadmium enters into environment by many anthropogenic sources [16]. Cd is emitted into air by use of cadmium compounds for preparation of alloys, batteries, as pigments in paint industries and plastics in mines, metal smelters and industries [8]. Along with industrial air emissions, waste water and widespread use of fertilizers and pesticides to agriculture lands are also the sources of environmental cadmium contamination [16].

Presence of cadmium in the environment is toxic to plants, animals, microorganisms and mainly to humans [16]. Humans get exposed to this toxic element primarily by inhalation (eg. Tobacco smoking) and ingestion (plants and animals). The plants will readily absorb Cd and stores in stem, leaves and fruits on which animals feed. Those affected animals and plant food products also acts as source of Cd to humans [24]. After the metal gets absorbed in human, it will accumulate inside the body for longer periods [18]. Hence, the diets which include meat especially liver and kidneys, products from marine mammals, plants (including rice and tobacco) that are grown in contaminated soils with Cd may result in high intake of Cd to humans. International agency for cancer research declared Cd as carcinogen under group I classification. (Table-1).

Cadmium in higher concentrations is highly toxic to kidney, as it accumulates in proximal tubular cells and also causes bone mineralization either through bone damage or by renal dysfunction [18]. Along with disturbances in Ca metabolism, formation of renal stone and hypercalicuria, studies on humans and animals also revealed that osteoporosis is a critical effect of cadmium exposure [18]. On ingestion of higher amounts of cadmium leads to stomach irritation and finally results to vomitions and diarrohoea. Cd may leads to premature birth and reduced birth weights in pregnant women [9].

Now-a-days, meat and its products have become important and highly nutritious components in human diet. Hen's eggs are also considered as highly nutritious and most important food in human diet. Lead ingested by hens via contaminated feed is deposited in bones, soft tissues and eggs [20]. Food is also a major source of cadmium exposure. Hence, the meat and its products, eggs indicates a potential public health hazard. After several studies on food additives and their toxicity, WHO has concluded that even low levels of lead and cadmium can cause disease in humans.

MATERIAL AND METHODS

Study area and sample collection:

A total of 53 liver samples and 26 eggs were collected from different localities in and around Tirupati region, Andhra Pradesh, India. Liver samples were collected aseptically in pre-sterilized bottles and transported to the laboratory under 4^{o}c for further processing to assess the presence of lead and cadmium in them.

Sample preparation:

The glassware used for estimation of heavy metals were cleaned and sterilized with detergent and rinsed for several times with tap water to remove detergent remnances; later glassware soaked in 6N HNO_3 for overnight and finally rinsed with deionised water.

Chicken liver samples:

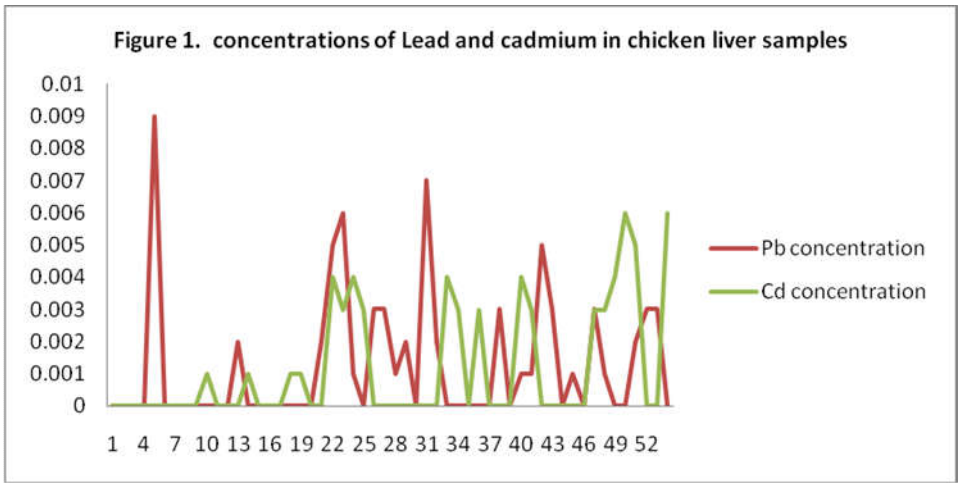
The liver samples were processed for analysis on the day of collection by wet digestion procedure. Two grams of each liver sample was weighed, homogenized manually and taken in a digestion tube. The sample is pre-digested in 10ml of Conc. HNO_3 at 135^{0}c until liquor was clear. Then add 10ml HNO_3, 1ml of $HClO_4$ and 2ml of H_2O_2 at 135^{0}c for 1 hr until the liquor become colourless. The product is evaporated to dryness, cooled and digested in 1M HNO_3. Then the substrate was filtered through whatman filter paper No.1 and it is diluted to 25ml with 1M HNO_3. Finally, the samples were subjected for ICP-OES [1].

Egg samples:

Five grams of egg-white sample was taken in a beaker containing 5ml HNO_3 and 2ml $HClO_4$ and covered with watch glass. The volume of this mixture is reduced to 3-5ml through evaporation by heating. Then 10-15ml of deionised water and filtered through acid washed filter paper No.1. Later, the filtrate was diluted to 50ml deionised water in a volumetric flask which was presented for estimation of heavy metals with ICP-OES. The blank solution was prepared without egg-white which is similar to procedure followed by [20].

RESULTS AND DISCUSSION

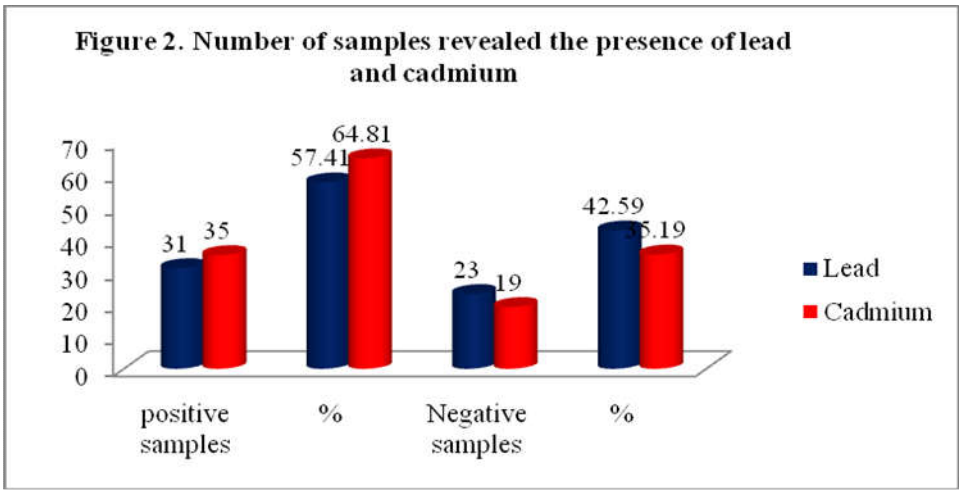
A total of 53 chicken liver samples and 26 egg samples were presented to ICP-OES for determination of lead and cadmium and the results of liver samples were represented in Figure 1. Out of 53 liver samples examined for presence of lead and cadmium, only 31(57.41%) samples were positive for lead and 35 (64.81%) samples were shown cadmium (Figure 2). But the lead and cadmium was not detected in all 26 egg samples.

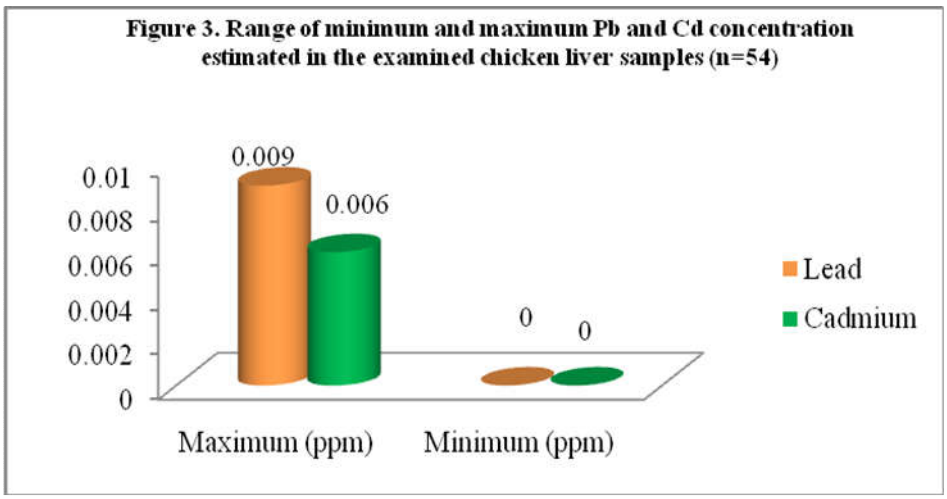


The maximum concentrations of lead and cadmium in chicken liver samples are 0.009ppm and 0.006ppm. The minimum concentration is zero for both heavy metals (Fig.3). Both the concentrations of lead and cadmium were within the permissible limit. While the lead and cadmium concentrations in eggs were not detected.

Lead and cadmium are toxic heavy metals which were present naturally in environment in lower quantities. Because of anthropogenic activities, these metals will enter into the food web. The high amount of lead results in reduction of cognitive development and intellectual performance in children and also increases blood pressure and cardiovascular diseases in humans. Lead also damages kidneys

and reproductive system [12]. Excess amount of cadmium accumulation results in skeletal damage, dysfunction of kidney and reproductive deficiencies [4].





Several researchers like Reem *et al* [21], Ismail and Abolghait [10], Gonzalez [6], Ramadan et al [20] reported higher concentration of lead (0.171-3.269 mg/kg, 0.131- 1.5107 ppm, mean concentration of 3.16 mg/kg, 0.199 to 0.23 mg/kg) in chicken liver samples. Uluozlu *et al* [24] also recorded a high prevalence of lead (0.01 to 0.40 µg/g) in chicken samples from Turkey.

The cadmium levels in chicken samples in the present study were lower than the studies conducted by Ismail and Abolghait, [10] (0.0025 to 0.0765), Gonzalez, [6] (4.15mg/kg), Ramadan et al, [20] (0.04 to 0.085 mg/kg). Many researchers like Kurnaz and Ayhan, [12], Uluozlu *et al* [24] (Tokut), Iwegbue [11] (Nigeria), Mariam *et al* [16] (Pakistan) reported lower levels of cadmium in their studies.

The present study revealed that the lead and cadmium were not detected in eggs. In contrast to the present study, Farahani *et al* [5] recorded higher levels of lead (0.225 to 5.363 mg/kg) and cadmium (0.025 to 6.388 mg/kg) from egg samples in Iran. The findings of Siddiqui *et al* [22] also reported high levels of lead; but the cadmium was not detected in egg samples which are similar to the present study findings. Several researchers like Fakayode and olu-owalabi [3] Khan and Naeem [11] reported the high levels of lead and cadmium than the present study.

The presence of lead and cadmium metals in chicken meat and eggs may due to feeding the poultry with metals as feed additives and trace elements, using metallic buckets for feeding, pesticides for cleaning the shed, treatment with medicines containing cadmium. These heavy metal contamination which is due to the rapid population growth, urbanizations and industrialization, can be reduced good handling practices and good processing techniques of raw materials. The heavy metal contamination in animal meat is due to grazing of plants grown in industrial area, drinking contaminated water with industrial waste, slaughtering in an area contaminated with heavy metals in air and transportation. These can be avoided by proper covering of meat at slaughtering area and shops which reduces most of aerial contamination of

heavy metals. Thorough washing of meat with water before cooking or consumption can removes heavy metal deposits partially [14].

CONCLUSION

In conclusion, the concentrations of the lead and cadmium recorded in this study are less than the permissible levels and statistically significant. Though the concentrations of lead and cadmium were within the safe limit, there should be continuous surveillance and monitoring to prevent bioaccumulation as they cause severe health hazards in humans. The information obtained from these types of studies will be helpful to frame guidelines and standards for heavy metals in foods. Public awareness on hazards associated with consumption of foods contaminated with heavy metals should be improved through print and electronic media. Public should also educated to consume fresh and covered meat; washing of fruits, vegetables and meat before consumption thoroughly to remove traces of pesticides which contains heavy metals, to buy and use environmental friendly products.

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