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Estimation of lead level in poultry drinking water in Namakkal district of Tamil Nadu

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Abstract
Water quality attributes can have a direct or indirect effect on poultry performance. Environmental pollution with heavy metals, especially lead is considered as a very serious concern because these metals cannot be degraded and stay permanently in the environment. In this study lead concentration in poultry drinking water was estimated in Namakkal district of Tamilnadu. The samples were collected from 90 poultry farms in the Namakkal district. The collected samples were analyzed by graphite-furnace atomic absorption spectrophotometer to determine the concentration of lead. The results of the study showed that the concentration of lead in poultry drinking water samples in the Namakkal district ranges from 0.00 ± 0.00 to 3.59 ± 1.82 ppb, which were within the permissible limit (10 ppb). Hence the poultry drinking water is safe for consumption.

Keywords: lead, poultry, water, Namakkal district

Introduction

Heavy metals pollution in aquatic environment is a growing current problem and worldwide it has reached an alarming rate (Hussain *et al.*, 2017) [1]. Due to the changing environmental conditions and extreme use of agrochemicals, heavy metals are being accumulated in soils which are transferred to water system by leaching, which poses a serious threat to human and animal life (Nicholson *et al*. 2003; Wong *et al*. 2003) [2, 3]. Lead is a most toxic heavy metal and commonly distributed throughout the environment (Greenwood and Earnshaw, 1984) [4].

Lead occurs naturally in uncontaminated aquatic and terrestrial ecosystems at relatively low levels. Toxic organic forms of lead are also present in the environment from direct inputs, including the manufacture, transport, storage and combustion of leaded petrol and the possible chemical/biological methylation of inorganic lead in anaerobic sediments (Odiete 1999, Eja *et al*. 2003) [5].

Lead is a cumulative toxicant that affects multiple body systems, including the neurological, haematological, gastrointestinal, cardiovascular and renal systems (WHO, 2010) [7]. The exposure to lead during developmental stage may result in mental retardation, impaired cognitive function, behavioural problems, and developmental delays and also associated with neurodegenerative disorders in later part of life especially in humans (Yuan *et al.*, 2013) [6].

Lead also accumulates in food producing animals via contaminated feed, water and feed additives and ultimately may enter the human body through food chain and threaten human health (Yuan *et al.*, 2013) [6]. Long term intake of low level of lead can suppress the immune function in birds (Vengris and Mare, 1974) [9]. Higher levels of lead in water (above 1.0 ppm) will affect the poultry health and cause residue problems (Fairchild and Ritz, 2015) [8]. Lead was also proved to enhance the antibiotic resistance in enteric bacterial flora of poultry (Nisanian *et al.*, 2014) [10].

In India, Namakkal district of Tamilnadu is known for its body building industry for trucks, trailers, tankers and rig unit. Moreover nearly 4000 small units are available for repairing heavy vehicle related problems (https: familypedia.wikia. org/wikia/Namakkal_district). Being a transport city, spilling of used engine oil, motor oil, improperly disposed batteries are the common sights, which might be easily leached into water sources. The district is also well known for its poultry and dairy industries, accounting for a bulk of supply of poultry products to neighboring industries. In fact it produces about 65% of the egg output of Tamilnadu. (https://shodhganga.inflibnet.ac.in/ bitstream/10603/51141/7/07_chapter%201.pdf).

Hence the study was planned to estimate the lead level in the poultry drinking water in Namakkal district of Tamil Nadu.

2. Materials and Methods

2.1 Study area

Namakkal district was selected as the study area, as there is no previous study in exploring the lead level in poultry drinking water.

Namakkal district is bounded by Salem on the north, Karur on the south, Trichy and Salem on the east and Erode on the West. The Geographical area of the district is 3363.35 Sq.Km which lies between 11.000 and 11.360 North Latitude and 77.280 and 78.300 East Longitude. It consists of 15 blocks namely Namagiripettai, Sendamangalam, Mohanur, Puduchatram, Rasipuram, Vennandur, Namakkal, Erumapatti, Kollihills, Elachipalayam, Mallasamudram, Tiruchengodu, Pallipalayam, Paramathi and Kabilarmalai (https://namakkal.nic.in/about-district). Six poultry farms from each block were selected following Systematic Random sampling method, based on its location, which is either nearer to road / lorry repairing units / petrol bunk.

2.2 Sample collection

Ninety water samples were collected from 90 poultry farms to assess their lead level. About 100 ml of water sample was collected in polyethylene bottles. Before sample collection the bottles were acid washed and immediately after collection, the samples were acidified with nitric acid to pH < 2 (Industrial waste resource guidelines www.epa.vic.gov.au).

2.3 Estimation of elemental lead in processed samples

The concentrations of lead in the water samples were determined by graphite-furnace atomic absorption spectrophotometer (GAAS, Model 3030, Perkin – Elmer, USA) at the Centralized Instruments Laboratory, College of Veterinary and Animal Sciences, Mannuthy, Kerala (Yuan *et al.*, 2013) [6].

2.4 Mapping

Namakkal District map was characterized by large scale detail. ArcGIS 10.1 a geographic information system (GIS) software was used for compiling and analysing geographic data using maps. Georeference coordinates (Latitude and Longitude) along with block average of lead levels for each sample were fed to the software to create map with different colours (Choropleth map) with classes like low, moderate and high (Pavithrapriya *et al.*, 2015) [21].

2.5 Statistical analysis

The data of the lead level in poultry drinking water samples from Namakkal district were analyzed by one way ANOVA procedure using SPSS® 20.0 software package for windows. Post-hock analysis was done by Duncan's significance difference test (Snedecor and Cochran, 2007) [20].

3. Results and Discussion

The mean values of lead concentration in poultry drinking water for each block in Namakkal district of Tamilnadu are presented in the Table 1 and mapped in Map 1.

There exists no significant difference in poultry drinking water lead level between the blocks of Namakkal district. But numerically highest concentration was noticed in Puduchatram followed by Mallasamudram and Pallipalayam blocks. The concentration was not in detectable range in the Kollimalai block. The lead concentration in all water samples were within the permissible limit of 10 ppb. The difference in lead level in water in different geographical regions may be due to its geological composition (Fairchild and Ritz, 2015) [8]. In Kollimalai block the undetectable lead level might be due to the weathering of bedrock and soil which controls the lead level in the mountain drainage water. In addition to that lead is taken up by particles (mostly hydrous iron oxides) in the stream of water in the mountain area at a relatively constant rate. (Yigal Erel *et al.*, 1991) [19].

Table 1: Lead level in poultry drinking water (Mean ± SE) in Namakkal district of Tamil Nadu

S. No.	Name of the block	Water (ppb)
1	Namagiripettai	0.54 ± 0.16
2	Sendamangalam	1.00 ± 0.35
3	Mohanur	0.41 ± 0.19
4	Puduchatram	3.59 ± 1.82
5	Rasipuram	1.20 ± 0.32
6	Vennandur	0.72 ± 0.19
7	Namakkal	1.01 ± 0.32
8	Erumapatti	0.77 ± 0.16
9	Kollimalai	0.00 ± 0.00
10	Elachipalayam	1.15 ± 0.30
11	Mallasamudram	3.13 ± 1.72
12	Tiruchengodu	1.70 ± 0.46
13	Pallipalayam	2.18 ± 1.26
14	Paramathi	1.05 ± 0.16
15	Kabilarmalai	0.60 ± 0.13

In India water samples at different areas were analyzed by many authors (Gowda *et al.*, 2003, Raj *et al.*, 2006, Khageshwar Singh *et al.*, 2010, Prem Nawaz *et al.*, 2017) [18, 16, 15, 17] and they reported that the lead level in water was above the permissible level. It was because they collected the water samples from the industrial effluent and sewage polluted area. But in this study the water used for drinking of birds in the farm was collected and analyzed. Hence all the values were within the permissible limit.

4. Conclusion

By this study it is concluded that the water sources in Namakkal district was not contaminated with lead leaching from the

environment. Hence poultry drinking water is safe for the birds and will not create any health, production and residue problems.

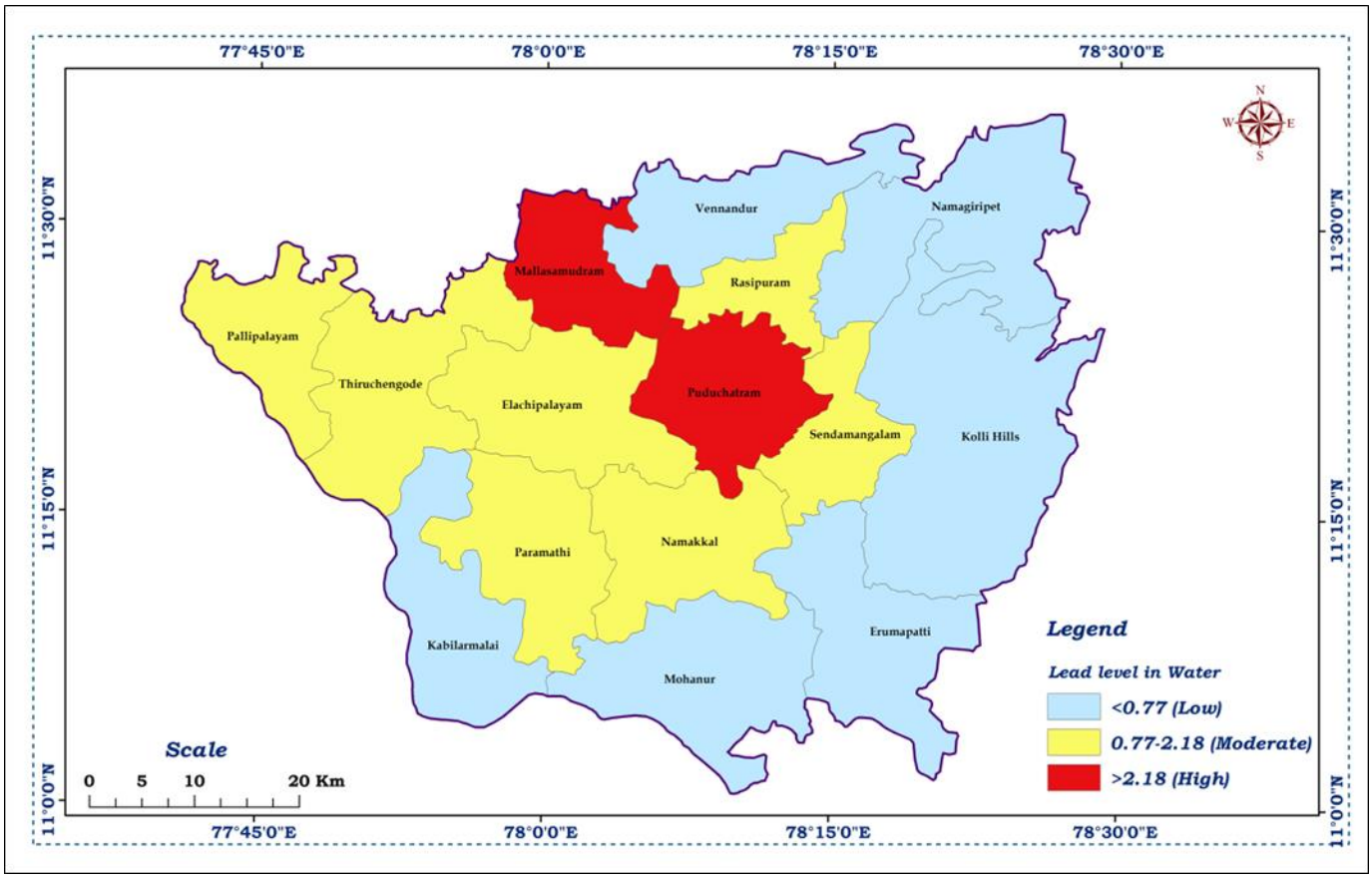

Fig 1: Lead level in water (ppb) in Namakkal district of Tamil Nadu

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