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Bio-monitoring of Metals in Chicken Eggs

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Abstract: ***Today, an increase of heavy metals due to industrial waste, geochemical structures and agricultural activities is a serious problem for environmental and human health. Therefore, monitoring ofheavy metals is necessary because these may have negative effects at several levels, from a biochemical response to population level, and may result in toxicity to living organisms.The objective of the present study is apply for risk assessment of urban pollution by heavy metals .The chicken eggs are prominently consumed by human being hence thus cause a significant bioaccumulation via food chain. Chicken eggs collected from various sites of Ajmer andKekriand analyzed for the concentration of heavy metals(Pb,Zn,Cr and Cu) by Atomic Absorption Spectrophotometer(AAS) .Mean concentration of heavy metal have been found significantly higher in the subjects belongs to the urban areas as compared to the rural areas.***

Keywords: Chicken eggs, metal, AAS

1. Introduction

Metals have been used by human for thousands of year.Right from the increasing industrial and technological uses of metals are measurements of human progress. Although heavy metals are naturally spread by human activities such as rapid industrial production and urbanization, mining fossil combustion, smelting operations, coal burning in power plants, high tension lines at roads sides, plastics waste, textiles wood preservation, volcanic eruptions and weathering natural factor and refining nonferrous metals as well as spread of sewage sludge over farmlands can release pollutants especially toxic heavy metals into the environment (Jarup& A kesson,2009).

The egg is one of the most common source of protein in diet of Indian population.AdditionallyEggs used as evidence for environmental pollution since they can accumulate the heavy metals from diet and environment (Burger *et al* 2009). Besides avian eggs have been proven to be vulnerable to external application of toxicants and represent local exposure of the adults have laid them. It has been proven exposure to heavy metals and their accumulation in human body starts at an early age via food consumption. Therefore egg consumption with high load of metalsmay cause health risk especially forthe person who takes egg regularly.

The human health risk assessment requires identification, collection and integration of information on hazardous chemicals their exposure and also the relationship between exposure and adverse health effects (Sobhanardakani2017).

The objective of this study wasto determine concentration and effect of zinc,copper,leadand chromium in egg content of chicken and to estimate the health risk to local consumption from ingestion of metal eggswith metal load. Since awareness of metal concentration in egg is increasing so egg can be a bio indicator to monitor metal pollution.

The species residing at the higher trophic level accumulated more burden of heavy metals compared to those species at lower trophic level. Heavy metal concentration varies within and among clutches, but no consistent trend has yet been observed. (Mohammad et al. 2015). These data demonstrate that eggs are sensitive indicators of geographic and temporal trends of heavy metals in soil. The published literature suggested that eggs may be effective monitoring units for detecting geographic, species, and temporal patterns of heavy metal contamination in terrestrial ecosystems and aquatic ecosystems.

Present study to determine the concentration of these metals in chicken eggs of subjects residing near urban and sub urban areas of Rajasthan. This study conducted by random sampling of chicken egg from various study areas.It was hypothesised that there might be difference in concentration of Pb, Cu, Cr and Zn in chicken egg of subjects residing near urban and sub urban areasin comparison those in poultry farm feeding on nutrich feed. Egg analysis is rather advantageous because it can reflect the total body intake of certain elements better than biological fluid, even though careful evaluation of exogenous contamination is mandatory (Petrucci*et al* 2004).

2. Materials and Methods

For this study samples were used as bio-monitoring material. In this research paper chicken egg as experiment materials and determined the level of exposure of Pb, Cu, Cr and Zn values through egg of Ajmer, Pushkar, Kishangarh and Kekri city.

Digestion of samples

Samples **of chicken egg** were collected simultaneously from different areas Urban and sub-urban area of Ajmer, Pushker, Kishangarh and Kekri). From each place 20 eggs (in four times in a month) werecollected randomly.Egg selected for theanalysis must not be older than five days (Altmeyer1995) and (Altmeyer and Paulas M.1991). For control samples collected from dairy farm where nutrich layer feed was given to laying hen.

The steps of processing were: homogenization of the total egg content with a mixer and then this homogenate used as sample, for the digestion samples were taken in glass tubes, nitric acid and per-chloric acid (8:2 ratios) were added to

each sample. The entire rack of tubes was then placed in the water bath; they were kept in the water bath for 8 to 9 hours or until the samples were clear. These samples were transferred to beakers. To every beaker 15-20 drops of 30% hydrogen peroxide were added and digestion was continued until 0.5 ml to 1 ml of colorless liquid remained. After cooling each sample was diluted up to 10 ml with deionized water and transferred to the plastic containers.

For lead, copper, zinc and chromium analysis double beam atomic absorption spectrophotometer was used.

3. Calculation

$$\text{Concentration of metal (ppm or µg/gm)} = \frac{\text{AAS Reading x Sample volume (ml.)}}{\text{sample wt (gm) (dry weight)}}$$

4. Significance

The probability for obtaining 't' value for a given degree of freedom (df) was determined by comparing the 't' values with the probability for a given degree of freedom 'P' values are signified according to the following conventions.
a = p < 0.05 almost significant
b = p < 0.01 significant
c = p < 0.01 highly significant

5. Results and Discussion

The absorption or depletion of metals in chicken egg may occur due to environmental and occupational exposure. Although the relationship between concentration of trace elements in chicken eggs and environmental exposure to metals is very complex, Data on the concentration of various metalsof Ajmer, Kekri,Pushkar and Kishangarhand of control group(poultryFarm) are given in table 1.

Table 1: The concentration values of metals (ppm) detected in chicken eggs samples collected from different places

Experimental areas	Concentration of metals in ppm			
	Pb	Cu	Zn	Cr
Ajmer city	8.63±0.46 c	5.84±0.15 b	70.33±7.66 b	5.75±0.49 a
Kekri	4.33±0.29 c	6.34±0.08 a	93.50±1.00 c	12.90±0.46 c
Pushkar	21.69±0.37	23.10±0.18 c	120.42±14.81 c	13.55±1.89 c
Kishangarh	6.15±0.70 b	15.58±0.71 c	100.7±2.62 c	11.80±0.45 c
Poultry Farm	1.36±0.17	2.86±0.15	4.41±0.70	1.91±0.34

a-P(<0.05) ….Almost significant.
c-(<0.001)……Highly significant
b-(<0.01)……Significant
ND….not significant

As summarised in Table 1the concentration various metals in eggs ofcontrol group from poultry farm was low. The mean lead concentration in chicken eggs of subjects ranges from1.69±0.37 ppm/dw to8.63±0.46 ppm/dw and it was higher in Ajmer City.

Copper concentration in chicken eggs ranges from 5.84 ± 0.15 ppm/dw to 23.10 ± 0.18 ppm/dw. The mean concentration of copper in chicken eggs was though higher in the samples from Pushkar in comparison to the eggs of subjects residing in Ajmer areasand this difference was highly significant P<0.001.

Mean Zn concentration in eggs of subjects residing in Pushkar area i.e. 120.42 ± 14.81 ppm/dw was higher than 70.33±7.66 ppm d/w of subjects residing inAjmer. However concentration of Zn was high in all the places.

Chromium concentration in eggs ranges from5.75±0.49ppm/dw to 13.55 ± 1.89 ppm/dw.

The result of this study shows that thetoxic level of metals present in yolk of egg cause ultimate health hazards to human. Though these elements play a vital role in human health in permissible limit, but there is obviously a great deal of concern about the optimum intake and the safe range of each element. Significant levels of lead, copper, chromium and zinc in the sample sites indicate the presence of these metals in the samples as well as their proneness to the illness and hazards, in case of long term intake(Jaishankar*et al* 2014).

Study conducted by(Uluozlu et al 2009) lead as a toxic element can damage intellectual performance ,resulting in reduced cognitive development in children. It also causes cardiovascular disease and increased blood pressure in adults. From above discussion it can be concluded that increase in pollution in the environment which affects the human population nearby leading to various diseases.

The presence of metal in eggs is caused mainly by the manner of feeding and breeding the hens. Eggs from deep litter indoor housing contain the lowest amount of such elements, whereas free-range eggs contains more heavy metals, since they walk along roads or live near factories, they are exposed to eating plants polluted by heavy metal compounds. In turn, heavy metals in plants come from the soil, in which they, for instance lead, accumulate. (Mohammad et al,2015).It is enough to exceed the norm of heavy metals in eggs such hens. However, we must remember that high amount of such metals contained by egg is dangerous for our health and should not lead to overdose or poisoning.(Shahbaz, M, et al.2013)

According to the results of our study and the previous studies eggs appear to be good bio-monitors for Zn and can be used for diagnostic purposes, as indices for body status in humans as well as for detecting certain disease. It was also seen that in many districts, urbanisation and industrialisation has detractive effects to the eggs Zn levels related with increasing Cu and Pb levels. However, increasing Zn levels in eggs could be a monitor for high traffic density while decreasing could be a monitor for industrial pollution.

According to the Agency for toxic substances and Disease registry (ATSDR 2001), the presence of a substance may indicate exposure but not the source of exposure. However, the presence of Pb, Cu, Cr and Zn in the chicken eggs in individuals from the studied areas gave some insights about

some sources of exposure of chicken of these areas (Carmen et al2017).

6. Conclusion

Toxic heavy metals can have serious adverse impacts on human health. For this reason the present study is mainly focused on the evaluationof Pb, Cu, Cr, and Zn in egg samples collected from different areas of Ajmer city. Some of heavy metal such as Cu, Zn, and Cr act as micro nutrient at lower concentration but they become toxic at higher concentration .Small amount of these elements are common in our environment and diet and are actually necessary for good health but large amounts of any of them may cause acute or chronic toxicity .According to the results values for individual metals in all sample vary but concentration of Cu and Zn observed in all samples exceeded the maximum , long term consumption of egg especially by children can lead to chronic health effects Nagel et al (2001).Therefore, it is recommended to pay serious attention to pollution discharge into the environment monitor chemicals residue, especially toxic heavy metal content during the whole production process of poultry foods and research on the effects of hen diet supplementation with various metal contents.

Further studies based on habitat preference and feeding type can improve the evaluation of correlations of the residue pattern of the egg, the spatial pollution pattern and the risk assessment for the human population. Pollution of a complete city can be assessed with the help of a single colony by strict foraging of chicken at different places scattered widelywithin the city.

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