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Trace Element Concentration in the egg of *Gallus gallus domesticus* collected from Mumbai market, Maharashtra, India.

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Abstract: This study was conducted to evaluate eleven trace elements (Ca, Cd, Cr, Cu, Fe, Mg, Mn, Pb, Zn, As, and Hg) in albumin, yolk and shell in ***Gallus gallus domesticus*** egg by using Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES). Highest concentration of Ca was observed in yolk and egg shell followed by Mg, whereas Mg concentration was found highest in albumin. The concentration of various trace element were as follows: in albumin (egg white) Mg>Ca>Fe>Cr> Zn; in yolk (vitellus): Ca>Mg>Fe>Zn>Cr>Mn and in egg shell: Ca>Mg>Fe> Cr>Zn>Mn. The concentration of Cd, Cu, Pb, As and, Hg were not in the detectable range in all the samples. Mn level was below the detectable level in albumin. This can be attributed to poultry and impact of environmental factors.

Key Words: Trace metals, egg , ICP., *Gallus gallus domesticus.*

1. INTRODUCTION:

Eggs of ***Gallus gallus domesticus*** are known as the important source of high natural proteins, lipids, fatty acids, carotenoids, vitamins and essential minerals (Applegate , 2000; Herron and Fernandez , 2004; Kilic et al., 2002). In eggs, protein ovalbumin attracts Se, Hg, Zn, Cu, Mn, glycoprotein ovotransferrin and phosphoproteins bind Fe ions. But lipids of egg yolk can attract I, Cr, Ni and Zn (Dobrzanski etal., 2007). Poultry feed composition may affect the content of egg yolk and albumen (Dobrzanski et al., 2007; Kucukyilmaz et al., 2012). Noel et al., (2012) suggested that all trace elements may have toxic impact if consumed in excessive amounts or may cause element deficiency if present in insufficient amounts (Noel et al., 2012).

For consumers and manufacturers egg quality is an essential concern (Ahmad and Balander, 2003; Arazi et al., 2009; Li et al., 2017). Egg is used in many food items for the uptake of protein (Stadelman and Cotterill, 1990) across globe. From earlier researches of many scientists it seems that, addition of trace elements into the diets improve production performance, deposition of microelement, egg quality and nutrition.

Zinc and Manganese (both trace elements) are essential for the animal’s growth (Virden et al., 2003). Zn is required for cellular metabolism, and is also important for enzyme function. Zn containing proteins are present in over 160 enzymes among different species (O'Dell, 1992; Siegel, 1983). Zn deficient element shows increased susceptibility to infections, abnormal cell-mediated immunity, and depressed thymic hormone circulation (Fletcher, 1988), decreased viability and chromosomal aberrations (Hurley , 1981) and decreased weight (Pimentel et al., 1991; Edwards, and Baker, 1999, Joshi et al., 2014).

Manganese is also required for enzyme function, and metabolism (Hurley et al., 1984). It plays a critical role in glycosaminoglycan synthesis, carbohydrate metabolism, and lipid metabolism (Hurley et al., 1984). Hurley 1981, reported Mn is required for proper growth, skeletal development, and reproductive function. Mn deficiency in animals is exhibit by impaired growth, skeletal abnormalities, depressed reproductive function, and poor carbohydrate or lipid metabolism (Hurley , 1981).

Iron (Fe) is an essential trace mineral, it is required for several metabolic processes, including oxygen and electron transport as well as DNA synthesis (Bothwell et al., 1979). This element is widely spread in nature and is present in all ingredients used in commercial poultry diets (NRC, 1994). Iron also influenced yolk, hatchability of fertile eggs, hematocrit (Ht) and hemoglobin (Hb) of hens and chicks (Morck and Austic, 1981; Bertechini et al., 2000). Fe is required for increased egg production and high early growth rate of hatching chicks (Taschetto et al., 2017).

According to Nisianakis et al.,(2009) Cr distributes to yolk easier than albumen in all poultry species. Amatya et al.,(2005) showed that absorbability of Cr in inorganic form is inferior to Cr with organic complex. This trace element is involved in metabolic and (Ander-son,1987; Cupo and Donaldson,1987; Hayirli,2005) and anabolic profile of many nutrients (Lien et al.,1996,1999,2004). So, it can be a source of nutritional management strategies to overcome and metabolic profile in laying hens (Sahin et al 2018).

Calcium plays an important role in shell strength (Nys 1999, William et al., 2006), internal egg quality (Roudybush and Grau 1987and a essential component of the egg shells (Roudybush and Grau 1987). Decreased egg production, egg weight, egg specific gravity, feed consumption and bone density and strength are the main symptoms of calcium deficiency. Excess amount of calcium cause reduced egg production, egg weight, and feed consumption (Harms and Waldroup 1971).

Earlier reports suggested, that eggshell strength improved in hens when the Mg concentration in their diet was increased (Atteh and Leeson 1983a, b; Hess and Britton 1997; Kim et al., 2013). Mg metabolism is directly associated with Ca and P (McDonald et al. 2011). There is a relationship also exist between Ca and Mg respective to skeletal integrity and eggshell quality in hens (Shastak and Rodehutscord 2015). Hess and Britton (1997) reported excess of Mg in hens can also reduce the activity of parathyroid hormone, which reduces blood Ca and subsequently also egg production and shell quality.

2. MATERIALS AND METHODS:

The present study was carried out to assess the levels of heavy metals in ***Gallus gallus domesticus*** egg albumin, yolk and egg shells . The eggs were collected from Mumbai local market, Maharashtra. A total of 11 minerals calcium, cadmium, chromium, copper, iron, magnesium, manganese, lead, zinc, arsenic and mercury were analysed by using Inductively Coupled Plasma -Atomic Emission Spectroscopy (ICP-AES).

2.1 Sample Preparation:

0.1gm of sample was taken and 4 ml of concentrated HNO_3 was added to it and heated on hot plate. After boiling 1 ml of $HClO_4$ (perchloric acid) was added and heating continued to destroy the organic matter from the sample. Sample were diluted with distilled water to make the total sample volume to 10 ml. Blank was prepared by adding 4 ml. of concentrated HNO_3, 1 ml of $HClO_4$ and 5 ml distilled water to make the total volume to 10ml. Standard was prepared separately for each selected metals by diluting readymade stock metal solution of 1000 ppm. The stock solution of 1000 ppm was diluted with deionised water to varying concentrations of 0.10, 1.00, 10 and 100 ppm. Intensities of varying concentration of standard metal solutions were analyzed by ICP-AES.

3. RESULT AND DISCUSSION:

Present study shows that egg of hen have different levels of heavy metals.

In present study, concentration of Cd, Cu, Pb, As, Hg were below the detectable level (less than 0.001 ppm) in egg yolk and egg shell. Mn concentration was found below the detectable level in albumin. The concentration of various trace element were as follows: in albumin Mg>Ca>Fe>Cr> Zn; in yolk: Ca>Mg>Fe>Zn>Cr>Mn; and in egg shell: Ca>Mg>Fe> Cr>Zn>Mn.

In present work Fe concentration occurred in higher levels in eggs as compare to Zn and Cr, this result were similar with (Abduljaleel et al., 2011) they found that the eggshell and egg content have different level of trace element, this may be due to feeding behavior and diverse capability for birds to ingest soil and grass (Nisianakis et al., 2009). In addition many physiological and biological progression, feeding pattern, growth, molting and reproductive may affect the concentration of trace metals in bird eggs (Kim and Koo, 2008). Buckner et al., (1922) reported that hens can utilize the calcium in calcium carbonate for the production of both egg-shell and bones but that the calcium in tricalcium phosphate can only be utilized for the growth of bone and not for egg-shell production. A high Ca concentration relative to P increased the formation of Ca-phytate complexes (Wise 1983). Previous studies showed that Mg supplementation above 5 g/kg, at 4.7 g/kg, or at 3 g/kg increased the eggshell quality in laying hens (Mehring and Johnson 1965; West et al. 1980; Kim et al. 2013).

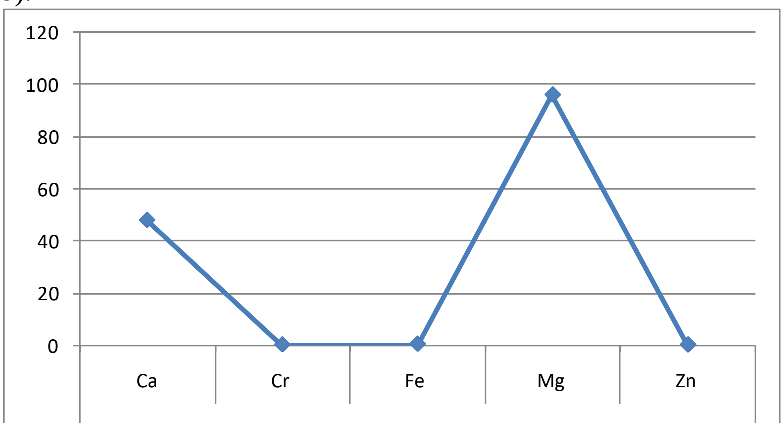

Figure 1: Heavy Metal in Egg Albumin (in ppm) of ***Gallus gallus domesticus***

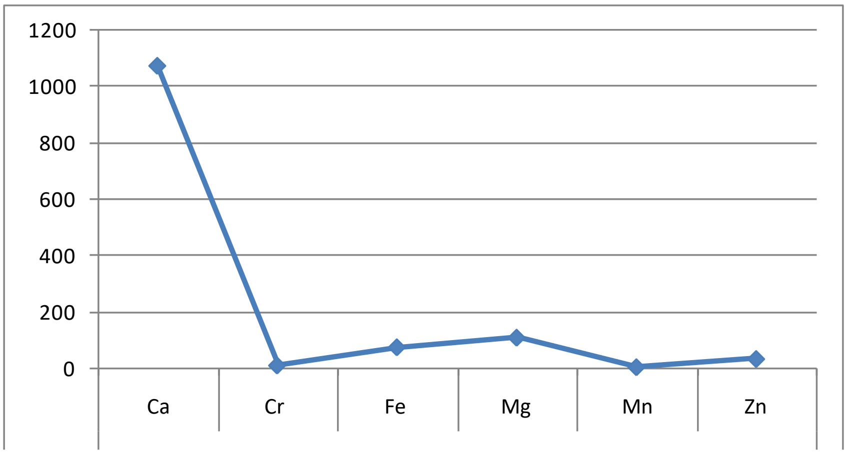

Figure 2: Heavy Metal in Egg Yolk (in ppm)of ***Gallus gallus domesticus***

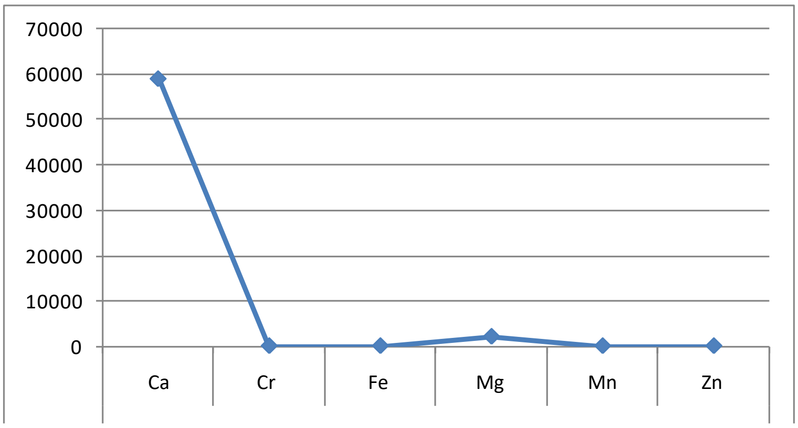

Figure 3: Heavy Metal in Egg Shell (in ppm)of ***Gallus gallus domesticus***

4. CONCLUSION:

Egg of ***Gallus gallus domesticus*** constitutes an important food ingredient in diet across globe. It is important to measure the heavy metal content since the ***Gallus gallus domesticus*** is fed with various food diet which may contain varying concentrations of heavy metals. The results indicate, concentration of Cd, Cu, Pb, As, Hg were below the detectable level (less than 0.001 ppm) in egg yolk and egg shell. The concentration of various trace element were as follows: in albumin Mg>Ca>Fe>Cr>Zn; in yolk: Ca>Mg>Fe>Zn>Cr>Mn; and in egg shell: Ca>Mg>Fe> Cr>Zn>Mn. The present investigation suggest that egg yolk and egg albumin of ***Gallus gallus domesticus,*** the level of calcium , iron and magnesium may be an appropriate, economic and good source of diet for human nutrition.

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