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ESTIMATION OF NICKEL FROM THE POULTRY ORGANS SURROUNDING TIRUPATI, ANDHRA PRADESH, INDIA

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Abstract: The present study was designed to determine the heavy metal (Nickel) residues from the liver samples of poultry. A total of 54 samples were collected from various retails chicken shops in and around Tirupati, Andhra Pradesh, India. The samples processed and subjected to Inductively Coupled Plasma Optic Spectroscopy method (ICP-OES) and the concentration of nickel were determined and expressed in ppm. A wide variation in the concentrations were found in different samples from various chicken shops. The minimum and maximum levels of nickel are 0.024 and 0.093 ppm respectively. The offal products especially liver is often used in meat products and important source of metals**.** The concentration of nickel in chicken liver falls in the range of 0.024 to 0.093 ppm. Nickel is known to be toxic at high doses and this will lead to health hazard to both animals and human. The determined nickel concentration is more than the permissible level of 0.5 ppm fixed by WHO in four liver samples. This research work helps the regulatory agencies to identify the sources of contamination of nickel in chicken organs and minimize the further bioaccumulation in public health aspects.

Keywords: Nickel, bio accumulation, poultry organs, ICP-OES.

Introduction

Heavy metals occur naturally in the environment and can be found in virtually all plant, animal, and food substances. Although small quantities of metals are necessary for human development, continuous and excessive exposure of heavy metals can lead to toxicity threatening human health. Previous studies have found that metal toxicity can result in pathological changes in the kidney, liver, gastrointestinal tract, bone, pancreas, testes, and blood vessels (Hunt et al., 1991). Foods contain a wide range of metallic elements such as sodium (Na), nickel (Ni) potassium (K), iron (Fe), (Ca) calcium, (Cu) copper and (Zn) zinc. Many of these metals are essential in living organisms. Nevertheless, a considerable number of them are harmful to plants, animals and man even at low concentration. Toxicological and

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environmental experts have shown concern for the increasing cases of food contamination with these heavy metals over the years as reported in several literatures.

Food is the most common and non-occupational source of exposure to heavy metals for humans. Although human bodies have homeostatic mechanisms that enable them to tolerate small fluctuations in metal consumption, concentrations far above or below certain levels can result in a range of acute and chronic negative health effects (WHO, 1996). Two common routes of exposure to heavy metals in the food supply are through crops grown in soil with high concentrations of metal and/or irrigated with polluted water and when animals graze in pastures with increased concentrations of heavy metals. The latter results in the bioaccumulation and/or biomagnification of metals in animal tissue. Meat is an important source of essential amino acids, minerals, vitamins, and energy (Rendle, 2010). All the essential amino acids required for life are highly bioavailable in muscle tissue, and liver is rich in vitamins, particularly vitamin A (Rendle, 2010) Meat is also an important dietary source of vitamins B_1 (thiamin) and B_2 (riboflavin). While meat provides an important source of nutrients, it can also be a source of heavy metal exposure for humans. Numerous studies from around the world corroborate the presence of heavy metals in meat mainly due to consumption of contaminated feed by birds and animals (Hanan *et al*., 2012).

Nickel is also beneficial to human health. It is an important cofactor for various enzymes and acts to accelerate normal chemical reactions occurring in the body. However, the ingestion of high levels of nickel may aggravate vesicular hand eczema and possibly eczema arising on other parts of the body, even in the absence of skin contact with nickel. Very high concentrations of nickel can induce teratogenic or genotoxic effects (WHO 1996). The major source of nickel exposure is oral consumption. Nickel is found naturally in both food and water, and may be increased by human pollution. People can be exposed to nickel in the workplace by inhalation, ingestion, and contact with skin or eye. In the US, the Tolerable Upper Limit of dietary nickel is 1000 µg/day, while estimated average ingestion is 69–162 µg/day. Large amounts of nickel comparable to the estimated average ingestion above – leach into food cooked in stainless steel. Reports show that both the nickel-induced activation of hypoxia-inducible factor (HIF-1) and the up-regulation of hypoxia-inducible genes are caused by depletion of intracellular ascorbate. The addition of ascorbate to the culture medium increased the intracellular ascorbate level and reversed both the metal-induced stabilization of HIF-1- and HIF-1α-dependent gene expression.

In view of the fact that there are very little or no available original data on content of nickel in organs of birds in India, studies were undertaken in order to determine the nickel levels in chicken liver in and around regions of Tirupati, Andhra Pradesh, India with concern on public health aspects.

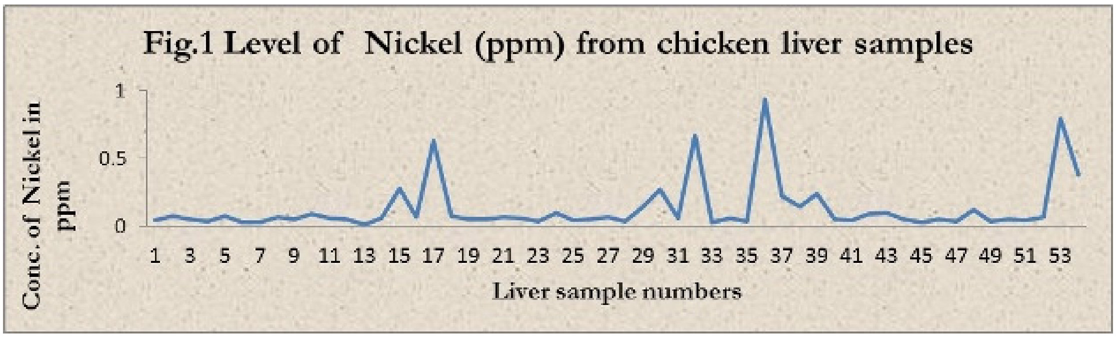
Materials and Methods

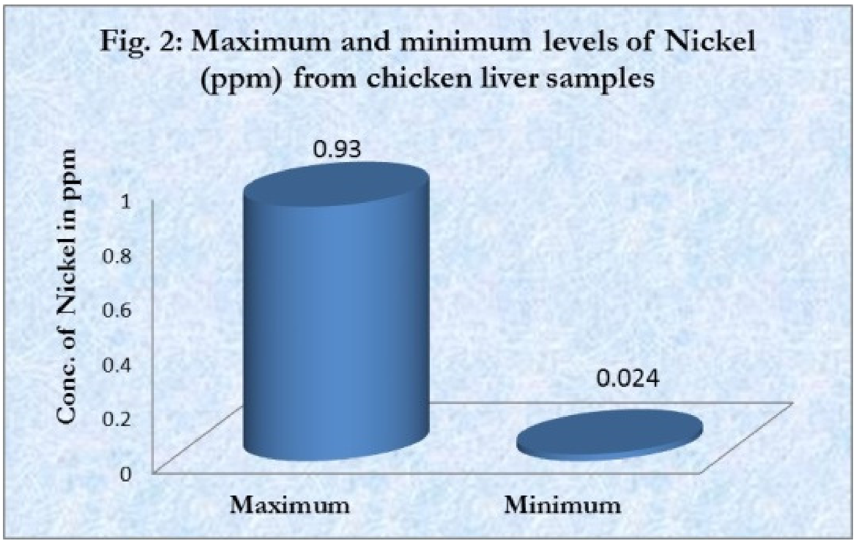
The present study was carried out at the Department of Livestock Products Technology, College of Veterinary science, Tirupati to estimate the level of Nickel residues in chicken liver samples using Inductively Coupled Plasma Optic Spectroscopy method (ICP-OES). The chicken liver samples (n=54) collected aseptically from individual retail outlet chicken selling counters which are located in various parts of Tirupati. The collected liver samples carried to the laboratory in sterile polythene bags. The samples were maintained at 4 °C until processing. The samples were processed on the same day of collection. 2 g of sample was weighed and homogenized manually using mortar and pestle. Wet digestion procedure was followed for the digestion of liver samples. 2 g of sample was placed in a digestion tube and predigested in 10 ml of concentrated HNO_3 at 135 °C until the liquor was clear. There after 10 ml of HNO_3, 1 ml of $HCLO_4$ and 2 ml of H_2O_2 was added and temperature was maintained at 135 °C for one hour until the liquor becomes colourless. Product of digestion was allowed to slowly evaporate to near dryness. It was cooled and digested in 1M HNO_3. The digests subsequently filtered through Whatman filter paper No .1 and diluted to 25 ml in 1 M HNO_3 (Belton, 2006). The digested liver samples were presented for Inductively Coupled Plasma Optic Spectroscopy method (ICP-OES).

Standard curves for the Nickel analytes were prepared from stock solutions (standard concentrations of 1000mg/ml) of metal analytes. To cover optimum emission working range 0.001 to 5.00mg/ml serial dilutions was prepared. Usually freshly stored standard curves in the system software where available and was used. Blank solutions were be also prepared accordingly. The external standard methods (Boss and Fredeen, 1997) of the Inductively Coupled Plasma Optic Spectroscopy method (ICP-OES) were used for the determination of heavy metals. The (PERKIN ELMER ICP-OES 7000 DV) operational with SVS auto sampler was used for the determination of heavy metals. Samples were analyzed under the instrumental operating conditions are: RF power 1.3 KW, outer argon flow 15.0 L/min, intermediate and inner argon flow 1.0 L/min and the nebulizer uptake rate (ml/min) 1.0 sample run were performed in replicate and integrated computer results of determinations will be recorded.

Results and Discussion

The level of concentration of Nickel in liver samples are vary between the various chicken selling retail outlets in and around Tirupati. Various levels of nickel has been determined in chicken liver samples (n=54) collected from retail shops of different locations in Tirupati by Inductively Coupled Plasma Optic Spectroscopy method (ICP-OES) presented in Fig.1. A wide variation in the concentration were found in different samples from various retail outlet counters. The minimum and maximum level of Nickel are 0.024 and 0.093 ppm respectively (Fig.2). The offal products especially liver is often used in meat products and important source of metals. The concentration of Nickel in chicken liver falls in the range of 0.024 to 0.093 ppm. Nickel is known to be toxic at high doses and this will lead to health hazard to both animals and human. Nickel is found in small amount in air, water, soil, and in food. Soluble nickel compounds are more toxic than insoluble compound (Goyer, 1991). When animal or human consumed nickel up to 5 g, it may lead to toxicity (Daldrup et al., 1983). Nickel (Ni) causes respiratory problem and is a carcinogen (ATSDR, 2004; Iwegbue et al., 2008). The level of intake of Nickel (Ni) as recommended by FAO/WHO should not exceed 0.2mg/kg per day. The permissible level of nickel at 0.5 ppm fixed by WHO was exceeded in four liver samples among observed. There are no set standards for nickel concentrations in meat by international bodies such as Codex Alimentarium and/or the WHO/FAO. Recently Russia has set a standard permissible limit of 0.5 mg/kg fw for nickel in meat and meat products. Then, World Health Organization has set a tolerable daily intake (TDI) of 5 mg/kg body weight for nickel. Crops of feed ingredients contaminated with runoff water from tanneries, electroplating plants, battery manufacturing industry, oil and ghee industries are responsible for the high levels of nickel whose acute exposure can cause lung, nose, larynx and prostate cancer and the low level exposure can cause dizziness, lung embolism, birth defects, asthma and chronic bronchitis, skin rashes (IOCCC, 1996) contact dermatitis (Cavania, 2005). Some nickel compounds have been categorized as extremely potent carcinogens but this is limited to only people having occupational exposure (Diagma *et al*., 2004). Zuhairi *et al*., (2015) studied the concentrations of nickel in the heart of beef, mutton and chicken and reveals that the nickel ranged between 0.6174and 0.2770 µg/g, while kidney concentrations ranged from 0.8794 to 0.3758 ppm. The levels of Ni is ranged between 0.2975 and 0.4146 ppm for beef meat, mutton meat and chicken meat respectively. The highest Ni concentration was observed in the meat of mutton, while lowest value (0.12243 ppm) was found in the mutton kidney. In one study, Iwegbue et al., (2008) reported that nickel can cause respiratory problems and is a carcinogen (ATSDR, 2004).





The upper tolerable Ni intake for children (1–3 years old) and adults (19–70 years old) is 7 and 40 mg/day, respectively. The highest mean level of Ni was found in turkey meat samples collected from Warri zone (20.78 mg.kg-1). The levels of Ni found in these samples did not exceed the upper tolerable intake levels of this element.

Conclusion

The research confirmed that the poultry organ especially liver being consumed in Tirupati is contaminated with nickel. This research helps the government agencies to identify the sources of contamination of nickel in chicken samples and further bioaccumulation in order to take safety measurements to ensure that these chicken livers and other chicken organs including meat are safe for consumption to safeguard the public health in India.

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