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Comparison of nickel content in broiler chickens and domestic chickens

Vergleich des Nickelgehalts von Masthühnern und Hühnern aus häuslicher Haltung

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Summary

Heavy metals are persistent in the environment and are subject to bioaccumulation in food chains. The present study was done to investigate the concentrations of Nickel in different organs of broiler and domestic chickens. Various organs (kidneys, livers, muscles, hearts and gizzards) of broiler and domestic chickens were collected from different shops and villages near Lahore. The samples were analyzed for Nickel concentration by using analytical technique of Atomic Absorption Spectrophotometer. Mean Ni concentration was significantly higher in various organs (kidneys, livers, muscles, hearts and gizzards) of broiler chickens as compared to domestic chickens. Highest mean Ni concentration was found in kidney samples of broiler chicken i. e. 2.3 ± 0.68 mg/kg as compared to other organs of broiler chicken. It is concluded that a large amount of heavy metals are added in feed given to broiler chickens to enhance their growth in short time span. Ni accumulates in body and may pose serious impacts to health.

Keywords: Nickel, feed, health effects, Organs, broiler chicken and domestic chicken

Zusammenfassung

Schwermetalle sind in der Umwelt persistent und unterliegen einer Bioakkumulation in der Lebensmittelkette. Die vorliegende Studie wurde durchgeführt, um die Nickelkonzentrationen in verschiedenen Organen von Masthühnern und Hühnern aus häuslicher Haltung zu untersuchen. Verschiedene Organe (Nieren, Lebern, Muskulatur, Herzen und Muskelmägen) von Masthühnern und Hühnern aus häuslicher Haltung wurden in verschiedenen Geschäften und Dörfern in der Nähe von Lahore (Pakistan) gesammelt. Die Proben wurden unter Verwendung der Analysetechnik des Atomabsorptionsspektrophotometers auf ihre Nickelkonzentration untersucht. Die mittlere Ni-Konzentration war in verschiedenen Organen (Nieren, Leber, Muskulatur, Herzen und Muskelmägen) von Masthühnern im Vergleich zu Hühnern aus häuslicher Haltung signifikant höher. Die höchste mittlere Ni-Konzentration wurde in Nierenproben von Masthühnern gefunden; 2,3 ± 0,68 mg/kg verglichen mit anderen Organen der Masthühner. Es wird der Schluss gezogen, dass eine große Menge Schwermetalle in Futtermitteln für Masthühner zugesetzt wird, um deren Wachstum zu verbessern. Nickel reichert sich im Körper an und kann die Gesundheit erheblich beeinträchtigen.

Schlüsselwörter: Nickel, Futtermittel, Gesundheitseffekte, Organe, Brathähnchen und Haushuhn

Introduction

An absolute balanced diet is requisite for the human health and vitality. A complete diet entails protein from either plant or animal resources. Pakistan is insufficiently producing protein from animal resources. At the present time, Pakistani natives are experiencing a deficit in protein in their daily food (Rehman et al., 2012). Meat is the most widely consumed source of proteins and fats including many essential metals. A total of 314.7 million tons of meat was produced globally in 2014 out of which, poultry meat accounted for 110.2 million tons (Imran et al., 2015).

Nowadays In order to raise the weight as well as for the prevention of diseases, numerous metals especially nickel are added to the poultry feed. In poultry feed, the incorporation of heavy metals is performed at a higher rate as compared to the indispensible value. To overcome the problem of deficiency these heavy metals are being used as supplementary diet. Mostly these are being used in poultry industry to meet the protein requirement and they are normally being used as mineral supplements (Oforka., 2012).

Hen's eggs are considered as a highly-nutritious food that is very effective and beneficial for human health (Sparks, 2006). However, eggs might contain high levels of heavy metals that originate mainly from water and food. Eggs also contain some mineral content that is becoming increasingly important for health and nutritional value of eggs, the consequences of egg metals on initial stage of embryonic development and its use as bio indicators for environmental metal pollution (Pappas, 2006). Altogether, chicken eggs, milk and dairy product constitute a major source of food around the World.

Major focus of poultry industry is to enhance the growth rate. Nickel 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. The highest nickel concentrations are found in the bone, lung, kidney, liver, brain and endocrine glands (Stixrude et al., 1997). In a study conducted by Abbas et al., 2017 high mean Nickel content in nail samples of male poultry farm workers was found because they were directly associated with the manual feeding operations. Present study was done to determine the Ni concentration in different organs of broiler and domestic chicken.

Materials and methods

Collection of Samples

In present study various visits of different markets were done for the purpose of sample collection. 50 sample of different organs of (kidney, liver, muscle, heart and gizzard) broiler and domestic chickens were collected from shops and villages around Lahore. All these samples were analyzed for the detection of nickel in laboratory. Atomic absorption spectrophotometer was used for chemical analysis.

Sample Preparation

All samples of broiler and domestic chickens were first washed by distilled water and then lead to drying. Each organ of broiler chicken and domestic chicken were taken into labeled Petri dish. Samples were placed in electrical oven at 90 degree Celsius for 24 hours to remove moisture. After drying, samples were crushed and grinded in a sand stone disc grinder to bring the samples in powdered form. 2 g from each sample was weighed by using analytical balance (TE313S-DS).The samples then taken in beakers for pretreatment.

Pretreatment of samples for Ni detection

2 g from grinded samples were taken in beakers and digested with a mixture of concentrated Nitric acid (HNO_3) and Perchloric acid ($HCLO_4$). The beakers were kept on hot plate for digestion. The digestion process continued until the solution became clear. The samples were then filtered by using what man filter paper and transferred to other flasks and diluted to 25 ml with distilled water (Pawan et al., 2006). Estimation of Nickel was estimated by Atomic Absorption Spectrophotometer (Thermo electron corporation). The treated samples were then stored in 15 ml test tubes and stored in laboratory refrigerator between temperatures of 4–6 °C for further analysis.

Results

From the results it was noted that high mean ± SD of Nickel concentration was found in kidneys of broiler chicken is 2.3 ± 0.68 mg/kg while in domestic chicken Ni content was found as 0.36 ± 0.2 mg/kg (Fig. 1). For comparison purpose t-test was applied and p value was found to be significant ($p = 0.05$). In livers of broiler chickens mean Ni content was found to be 2.13 ± 0.33 mg/kg and in domestic chickens was 0.22 ± 0.04 mg/kg as shown in Figure 2 ($p = 0.05$). Similarly high mean ± SD of Nickel concentration was found in Muscles of broiler chickens (1.89 ± 0.85 mg/kg) while in Domestic chickens mean Ni was found as 0.37 ± 0.10 mg/kg (Fig. 3).

Comparison of significantly high Mean ± SD of Nickel content in hearts of broiler chickens was found as 0.28 ± 0.12 mg/kg and in domestic chickens was 0.25 ± 0.03 mg/kg (Fig. 4). Similarly in gizzards of broiler chickens high mean Nickel content was 0.28 ± 0.14 mg/kg and low mean nickel concentration in gizzards of domestic chickens was found as

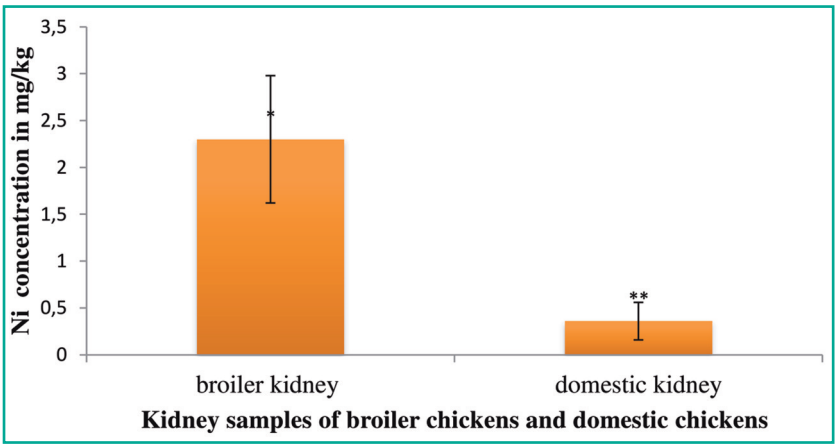

FIGURE 1: *Graph showing comparison of mean Ni concentration between kidney samples of broiler and domestic chickens.*

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0.15 ± 0.02 mg/kg (Fig. 5). P value was found to be significant ($p \leq 0.05$).

Comparison of nickel content in various organs of broiler chickens and domestic chickens show that highest nickel concentration was found in all studied organs of broiler chicken which was quiet higher than standard value recommended by WHO While Nickel concentration in various organs of domestic chickens was lower than the standard value i.e. 0.5 mg/kg.

Order of Nickel content in broiler chicken is as kidneys > livers > muscles > gizzards > hearts. Nickel concentration was much higher in kidneys of broiler chicken i.e. 2.3 ± 0.68 mg/kg as compared to other organs of broiler chickens. In domestic chickens Nickel concentration is according to the order Muscles > kidneys > livers > hearts > gizzards. Highest mean value of Ni is found in muscles of domestic chicken i.e. 0.37 ± 0.10 mg/kg.

Discussion

In present study Ni concentration was measured in different organs of broiler and domestic chicken. Current study also showed the trend of heavy metal accumulation was, mostly, higher in metabolic organs. These heavy metals perform many functions in body but their presence in excess amount may cause many toxic impacts (Chowdhury et al., 2011). According to Mariam et al. (2004) Nickel was higher in muscles, liver, skin and other organs of poultry. In our study similar trends of higher Ni concentration was found in different organs of broiler chicken. Broiler chickens are given such artificial feed containing antibiotics, hormones and heavy metals such as Ni, Cr, Cd, Mg, and Pb etc. to increase their growth rate. Most commercial broilers reach slaughter-weight at between five and seven weeks of age, although slower growing breeds reach slaughter-weight at approximately 14 weeks of age (Imran, 2015). While domestic chickens are mostly given natural feed.

The required levels of these metals must be used in animal feeds. Required levels of heavy metals are very essential for body growth, but it may cause many health problems not only to broiler chicken itself but also to consumers. Sometime heavy metals cause toxicity due to their toxic effects and bioaccumulation. These

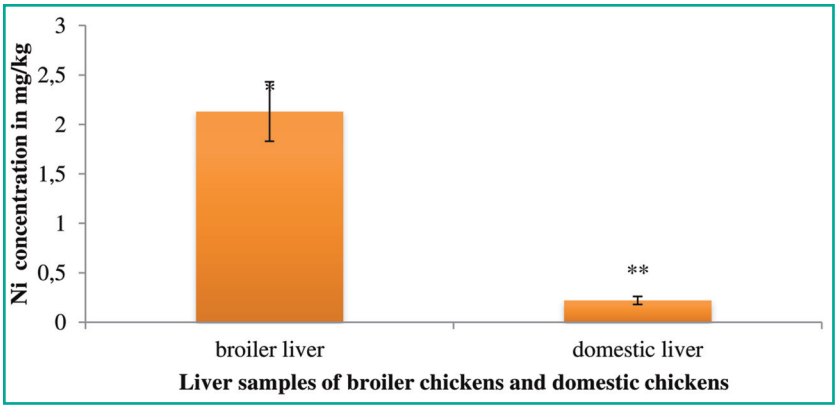

FIGURE 2: *Graph showing comparison of mean Ni concentration between liver samples of broiler chickens and domestic chickens.*

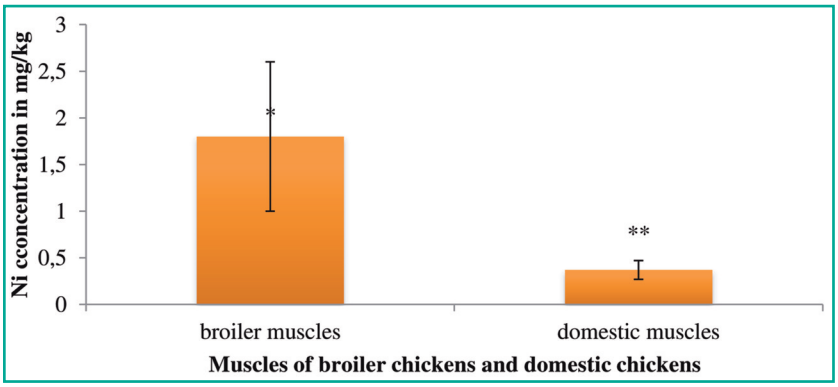

FIGURE 3: *Graph showing comparison of mean Ni concentration between muscle samples of broiler chickens and domestic chickens.*

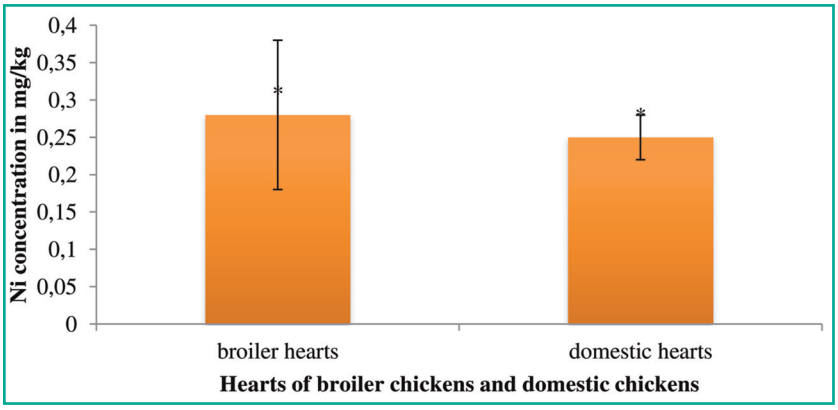

FIGURE 4: *Graph showing comparison of Ni concentration between heart samples of broiler chickens and domestic chickens.*

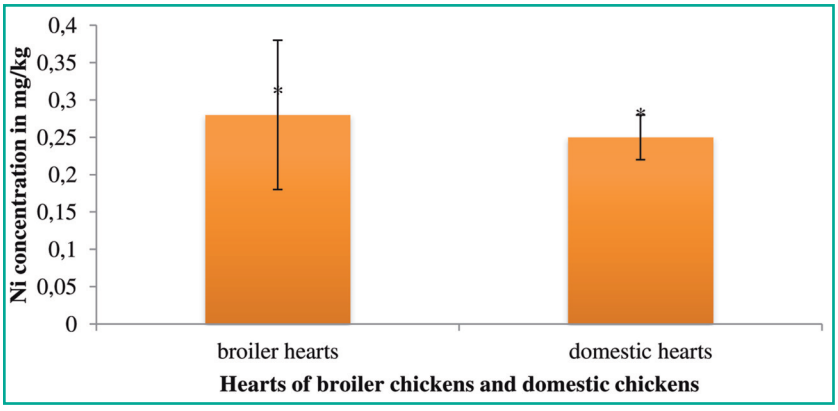

FIGURE 5: *Graph showing comparison of Ni concentration between gizzard samples of broiler chickens and domestic chickens.*

often have direct physiological toxic impacts because they may be accumulated in body tissues and cell (Rehman et al, 2013).

According to Donia (2014) high concentration of Nickel was found in kidney (5.42 ± 0.17 mg/kg) of migratory quail while in liver it was found as 1.21 ± 0.07, in heart 1.61 ± 0.68 and in chest muscle was 0.84 ± 0.29. The indistinguishable pattern was observed in the current study. Kidneys are responsible for cleaning the blood of toxins hence the highest level of heavy metals was found to have accumulated in them (Imran et al, 2015). A study carried out by carried out by Iwegbue et al. (2008) had similar results. They found Maximum percentage of heavy metals such as arsenic (27 %), chromium (14 %), mercury (14 %), were accumulated in kidney as compared to other organs of poultry.

In our study Nickel concentration was found higher in organs (kidney, liver, muscle, heart and gizzard) of broiler chickens when compared with the corresponding organs of the domestic chicken. Because domestic chickens are raised in natural environment organically. They fed certified organic feed for their entire lives. Organic feed do not contain animal by-products, antibiotics or genetically engineered grains and in the absence of persistent pesticides or chemical fertilizers. While broiler chickens are raised on feed containing heavy metals and antibiotics (Imran et al, 2014). Therefore, Nickel concentration was found to be lower in organs of domestic chickens and higher in organs of broiler chickens.

Conclusion

The basic aim of this study was to determine concentration of nickel in samples of broiler chicken and domestic chicken collected from different shops and villages around Lahore. Nickel is added in feed to stimulate growth and strength of chickens but if it is added in more concentrations than permissible value, it is proved toxic to human beings and animals. In our study we compared concentration of Nickel found in different organs of domestic chickens and broiler chickens. It is concluded from our study that Nickel was found in excess in organs of broiler chicken as compared to domestic chickens. Order of Nickel content in broiler chicken is as kidneys > livers > muscles > gizzards > hearts. Nickel concentration was much higher in kidneys of broiler chicken i.e. 2.3 ± 0.68 mg/kg. From our study it is clear that nickel concentration is much higher in organs of broiler chickens as compared to domestic chickens.

Conflict of interest

There is no conflict of interest between the authors.

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