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Determination of some trace elements in chicken eggs from different sources

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Abstract
For most people, diet is the main way of exposure of heavy metals and trace elements and consequently the risk assessment of these elements to humans through dietary intake is important. The purpose of this study was to evaluate the levels of Mn, Co, Cu, Se and As in egg of chicken and quail from different location. Trace elements were determined by inductively coupled plasma-mass spectrometry (ICP-MS).The result found that disparity in metals concentrations in eggs among avian species, the eggs of chicken were gathered high concentration of iron compare with lowest concentration of cobalt. Additionally, the eggs that collected from village have low concentrations of these trace elements while the high levels of trace element reported in the eggs that collected from commercial farms.

Keywords: Trace elements, egg, chicken, different, source

1. Introduction
Food safety is a major public anxiety worldwide in current decades due the growing require for food safety has stimulated research regarding the risks associated with consumption of foods contaminated with pesticides, heavy metals or toxins [1] Toxic elements can be very harmful even at low concentration when ingested over a long time period.
Chicken eggs are among the most essential and nutritious food in the daily diet. environmental pollution with heavy metal lead to an increased attention in metal contamination of food and amongst them eggs which represent an essential part of human's diet particularly children. On the other hand, eggs are an important way of chemical elimination for female birds, mainly for highly lipophilic compounds, and measurement of contaminants in eggs allows comparison of maternally deposited doses to those associated with toxicological effects in field and lab investigations. Additionally, egg is a highly nutritious food and can be an and especially for selenium in humans [2]. Birds deposit the trace element selenium (Se) into their eggs because an adequate supply of this micronutrient is essential for embryonic development [3]. Metals can bio accumulate over time to reach toxic levels, which can cause decreases in reproductive success and lowered survival [4]
In general, birds have served as bio indicator for a number of environmental contaminants predominantly heavy metals [5] as well, avian eggs have been shown to be susceptible to external request of toxicants and represent local exposure of the adults have laid them [6].
Therefore, the present studies were considered in order to assess the level of some heavy metals in the eggs of domestic birds with different location in Selangor, Malaysia and also to determine if egg can be used as non-invasive method to monitor metal level in environment.

2. Materials and Methods
The reagents with suprapur quality, analytical grade Nitric acid (70%) and hydrogen peroxide (30 %) were acquired from Merck (Darmstadt, Germany) along with the stock standard solutions of Mn, Co, Cu, Se and As in concentrations of 1,000 mg/l.

2.1 Apparatus
A Perkin Elmer model Elan 9000 inductively coupled plasma-mass spectrometry (ICP-MS, USA) was used in current study. After calibrating the apparatus with standard solutions derived from commercial materials, it was optimized according to the manufacturing standards the cones and tubes were carefully cleaned to get rid of any possible residues

2.2 Sample collection and preparation

Eggs sample from chicken (*Gallus gallus*), quail (*Coturnix coturnix japonica* were collected from commercial farm, the second sample were collected from village (different house), while the third sample from different markets and super markets located in Selangor city, Malaysia.

To analyze the metals in egg content according to method previously described by [7] with slight modification, the eggs were washed vigorously with de ionized water, then open carefully the eggshell separated from egg content, the egg content were homogenizes and put it in Petri dishes the samples were drying at 70 ºC for 24 h the egg content grain to powder by mortar, 0.5 g of the sample soaked in nitric acid 70% and hydrogen peroxide 30% overnight in room temperature, the digested completed in bloke thermostat (150 ºC) for 4hours until solution were clear. After cooling the solution was diluted to 50ml with de ionized water, then were filtrated throw 0.45 µm acid resistant filter paper. The solutions were stored at 4 ºC for later metal analysis. Concentration of metals were determined by inductively couple plasma-mass spectrometry (ICP-MS, model Perkin-Elmer Elan 9000 A). Each analysis was carried in duplicate, standard and blank samples were analyzed every 20 sample. All concentration were expressed in µg/g on dry weight basis.

2.3 Statistical analysis

All calculations were performed using SPSS for Windows (vers. 18.0, SPSS Ltd., Woking, Surrey, UK). The descriptive statistics (mean values, standard deviation) for values of egg content were analyzed by one-way analysis of variance followed by the Tukey honestly significant difference test. Differences were considered significant at the $p<0.05$ level.

3. Result

Result showed that disparity in metals concentrations in eggs among avian species. The concentration of heavy metals in chicken eggs are presented in table (1) in general, iron appear relatively high concentration in egg of chicken egg content iron level ranged between(20.3ug/g) and (50.3ug/g),while in egg of quail ranged between (51.4ug/g)and 88.5ug/g) figure 3. While cobalt have been the lowest concentration ranged (0.24-0.31ug/g), followed by arsenic figure 1.

The minimum and maximum Se content in the analyzed samples were found (2.4 and 1.1ug/g) in egg content of chicken. The level of Cu was between 2.5 -5.4 ug/g in chicken egg, while Mn concentration reached to1.98ug/g.

Result of study were found to be statistically significant at $p<0.05$) differences in Co level at three sources. on the other hand the concentration of Cu, Se, As were found to be statistically significant at ($p<0.05$) between sources, the lowest level were found at village than other source farms and market .The level of Mn and Fe were significantly high at commercial farms than other sources.

The levels of heavy metals Co, Se, As and Fe were significantly ($P<0.05$) high in eggs of quail collected from Commercial farms than other places (Table 2). On the other hand, Mn have higher concentration in eggs collected from markets, while there's no significantly, diverse among Cu concentration at three locations (figure 2).

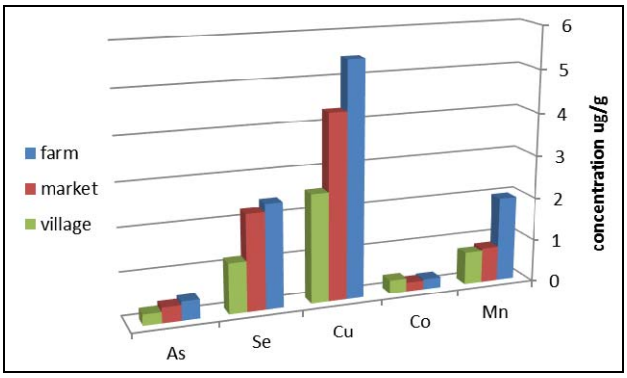

Fig 1: Concentration of trace element (ug/g)in egg of chicken

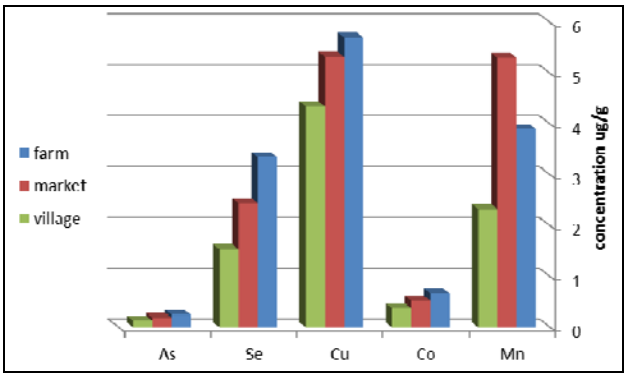

Fig 2: Concentration of trace element (ug/g) in egg of quail

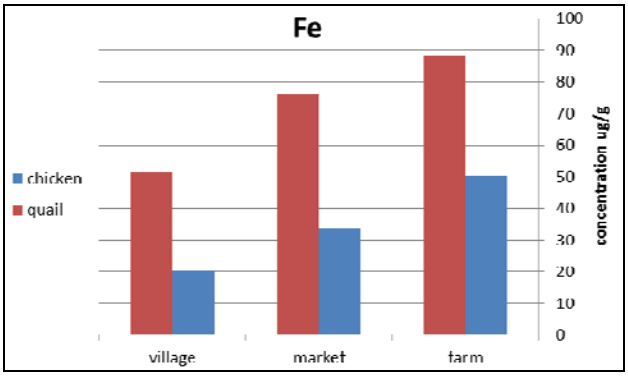

Fig 3: Concentration of iron (ug/g)in egg of chicken and quail in different source

Table 1: mean concentration of trace elements in eggs of chicken (ug/g±SD) dry weight

Trace elements	Commercial farm	Market	village
Mn	1.98±0.37a	0.82±0.12b	0.75±0.22b
Co	0.24±0.05	0.21±0.04	0.31±0.06
Cu	5.44±0.21a	4.31±0.14a	2.53±0.95b
Se	2.42±0.12a	2.23±0.03a	1.16±0.65b
As	0.43±0.07a	0.35±0.031a	0.25±0.04b
Fe	50.3±18.54a	33.51±9.87b	20.31±6.87b

Values with different letters within arrow are significantly ($P<0.05$) different

Table 2: Concentration of trace elements in eggs of quail (ug/g±SD) dry weight

Trace elements	Commercial farm	Market	village
Mn	3.90±0.93b	5.31±0.15a	2.33±0.24b
Co	0.67±0.12a	0.53±0.07a	0.38±0.04b
Cu	5.71±0.56	5.33±0.23	4.53±0.77
Se	3.35±1.31a	2.45±0.88a	1.54±0.04b
As	0.25±0.88a	0.19±0.013a	0.13±0.02b
Fe	88.5±20.51a	76.32±23.1a	51.41±15.8b

Values with different letters within arrow are significantly (P<0.05) different

4. Discussion

Present study created that egg of chicken and quail have disparity levels of heavy metals. Fe occurred in higher levels in eggs of chicken and quail, in same and different locations, this result were similar with [8] who found that the eggshell and egg content of chicken and quail gathered dissimilar levels of some trace element, this distinctions may be Resulted from feeding behavior and diverse capability for birds to ingest soil and grass [9]. In addition several physiological and biological progression, feeding pattern, growth, molting and reproductive may affect the concentration of trace metals in bird eggs [10]. Arsenic burden was found in high concentration in chicken egg content than quail egg content, and similar observation was also reported by [11] and [8]. As levels in chicken and quail egg was 0.3µg/g and 0.25µg/g these results are perceptibly lower than the permitted limits of 2.0 ppm [12].

In present study founded that heavy metals concentrations were slightly high in egg collected from commercial farm than eggs bring from markets, while the eggs were collected from village accumulated lowest concentration of these metals, equivalent observation were investigated by [13], they considering that to high compellation between the metal content in feed and the corresponding amounts of metals in eggs. but the little variation in the metal content of egg bring at different location, feed appeared to be the major contributor to the amount of metals in eggs [13.In addition the major component of chicken feed as grains (maize, soybean and wheat) which are the main component of feed could also accumulated metals and trace element from contaminated soil depended on location. Copper concentration was differ among location Cu found high in egg from commercial farm same record by [14] they found Cu levels was differ significantly from commercial and home produced egg samples but there is no significant difference between commercial and home produced egg samples. The examined eggs sample in present study had Cu concentration below the permissible limit (10ppm) according to Zmudzki and Szkoda [15]. Copper is necessary element for several enzymes in the body of the bird [16], the majority Cu is stored in liver, bone and bone marrow where it is bound to metallothionein.

Ping etal [17] found relationship between the levels of heavy metals in chicken and their feed like plant and insect. Regarding Se was slightly high in quail eggs compare with chicken egg while its level was elevated in commercial farm in two species. This finding is supported by [18] they reported different bird eggs can accumulated dissimilar level of selenium reflecting a linear correlation between yolk–albumen mass and Se content. In addition the importance of poultry products for humans, the accumulation level of Se in eggs seemed to be also of great importance for providing major amount of biologically available forms of Se. High Se transfer rate to eggs is that this trace element is very important for their antioxidant protection to the highly oxidative rate of the newly hatched chick. Se content of the egg was shown to depend on its concentration in the diet [19].

Attention in the trace element levels of eggs relates to research by environmental scientists on the embryotoxic effects of various trace elements on birds. An improved admiration of the range of egg trace element levels that are obviously achieved by domestic chickens kept under free systems at unpolluted sites would provide reference points for pollution effects and also direction in formulating nutritional supplements for free-living birds. In conclusion, present study shows that the content of several trace elements in eggs of the domestic species can be readily measured through the ICP-MS methodology and that these vary considerably among the location and bird species.

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