Assessment of Heavy Metals Content in Hun's Eggs

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Abstract

This research was assessment of some heavy metals concentration of hen's eggs and drinking water of hen collected from Yatsauk (battery farm and poultry farm) and Nyaung Shwe from battery farm. The samples were digested and analyzed for detection and measurement of cadmium (Cd), iron (Fe), lead (Pb) and arsenic (As) with Atomic Absorption Spectroscopy (AAS). The obtained results showed the value of cadmium (Cd), iron (Fe) and lead (Pb) in hen's eggs was lower than the World Health Organization (WHO) standard. Level of arsenic (As) concentration in all samples was lower than WHO standard except sample E2. Sample E2 was higher than the maximum permissible limit of WHO standard value. Cadmium (Cd) concentration in drinking water of hen from Yatsauk was higher than WHO standard. Concentration of iron (Fe) in drinking water of hen samples was lower than WHO standard.

Keywords: heavy metals, AAS, hen's eggs and WHO

Introduction

Eggs have constituted an important part of human diets for century because of its high quality protein but if contaminated by toxic heavy metals will cause a harmful effect on human health. They are known to supply the best protein beside milk. It is also rich in amino acids, carbohydrates, easily digestible fats and mineral as well as valuable vitamins. Eggs are one of the nature's most nutritious and economical foods of human daily diet and included in several food product for various functions. Hen eggs are important source of nutrients, containing all of proteins, vitamins and minerals. However, they are used as evidence for environmental pollution since they can accumulate the heavy metals from diet and the surrounding environment.

Poultry could take up heavy metal compounds from different sources, metal residues may concentrate in their meat and eggs. A large amount of these metals are taken by plants and animals and subsequently find their way into the food chain. This ever increasing pollution has given rise to concern about the intake of harmful metals that enter human body through inhalation, ingestion or absorption through the skin.

Toxic elements can be very harmful even at low concentration when ingested over a long period especially cadmium (Cd), lead (Pb) and arsenic (As). So, the primary techniques for analyzing heavy metal in eggs samples are based on atomic absorption spectrometry.

Measurement Connection for AAS

AAS is based on the absorption of virtually monochromatic light by a cloud of atoms of the detecting samples. The light is produced by emission from the same kind of atoms as those being determined. This means exactly that the same wavelength of light is produced as that being absorbed, and hence a high temperature flames [Oxygen-Acetylene] and graphite furnace. Atomic absorption using flame atomizers was rapidly accepted as a simple technique which gave high sensitivity, accuracy and precision.

Generating free atoms using an atomizer, which may be flame or a thermal atomizer. The absorption is measured at one of the several wavelength characteristics of the element

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being determined. Absorption by free atoms at other wavelengths is essentially zero. The wavelength is selected by using a monochromator and is measured by using a photomultiplier.

The flame warms up and auto-alignment of main console unit is reached in within 10 minutes to achieve the stated specification. Fuel adjustment, air adjustment and initial adjustment are PC's control. If something is wrong or out-offs operating setting input, AA Winlab soft-ware appears the setting error and closes the running operations. All alignment and operating systems (selecting the atomizer, setting up the burner system, changing a burner head, changing the nebulizer, igniting the flame, emergency shutdown, the drain trap system, gas(fuel) controls) are PC's controlled on the analyst 7000 Atomic Absorption Spectrometer.

First, open the main console unit, the AA Winlab soft-ware for AAS running operation, selection of detecting element, setting of sample, setting of optic, measuring and data management. Dual atomizers are automatic changeover by PC control. Automatic flame monitoring system, automatic sequential analysis of up to 10 elements, automatic sample mixing and serial dilution automatic search for the best fuel gas flow rate and the optimum flame analysis burner height, optimum temperature program search are software supports for depending on the application. The instrument A analyst 7000 has two way background correction. Hence, analysis with the highest possible sensitivity and high precision correction capability is conducted.

Sample Collection

In this research, the determination of heavy metals content in hen eggs from Yatsauk (battery farm and poultry farm) and Nyaung Shwe (battery farm) from the Southern Shan State. Sample-E1 was collected in Yatsauk from battery farm in figure (1), sample-E2 was collected in from poultry farm Yatsauk and sample-E3 was collected in from battery farm Nyaung Shwe as shown in figure (2).

Figure (1). Samples collected from Yatsauk battery farm.

Figure (2). Samples collected from Nyaung Shwe battery farm.

Sample Preparation

Sample preparation is very important for the atomic absorption spectroscopy method. Weight 10 g of sample into a 100 ml beaker and 10 ml of magnesium nitrate solution. Mix well and evaporate the alcohol by warming beaker on a water bath and complete drying of sample in an oven for one hour at 150Ċ. Remove sample and heat on a hot plate at about 200° C, gradually increasing to 400° C until organic matter is thoroughly charred. Place into a porcelain crucible by washing with few drops of HNO_3. The porcelain crucible put in a muffle furnace and ash overnight at 450° C. Remove and cool crucible, add a few drops of HNO_3, dry on hot plate, return to muffle furnace and ash for one hour. If the ash is not white, repeat the nitric acid digestion. Remove crucible, cool and add carefully 10 ml of extraction acid solution to dissolve the ash. Transfer the digestive sample to a 100 ml volumetric flask, add 40% W/V solution acetate solution to give a pH of 3-4, add 5 ml freshly prepared 1% aqueous APDC reagent (Ammonium Pyrolidine Dithio Carbonate) and allow to stard for 15 min. Add 10 ml MIBK (Methy Iso Butyl Keton) to the flask, stopper and shake vigorously for 3 min. Add deionized water put down the volumetric flask until the digestive solution rises into the 100 ml graduate mark of the volumetric flask. Sample preparation for hen's eggs is shown in figure (3).

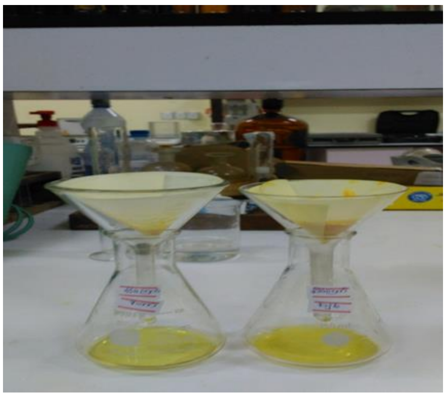

Figure (3). Sample preparation for hen's eggs.

Results and Discussion

In this research, the determination of heavy metals content in hen's eggs from Yatsauk (battery farm and poultry farm) and Nyaung Shwe (battery farm) from the Southern Shan State. Table (1) showed the elemental concentration contained in hen eggs samples. Figure (4) to (7) showed the comparison of cadmium (Cd), iron (Fe), lead (Pb) and arsenic (As) concentration in experimental results of hen's eggs and WHO standard level. According to the AAS results, in figure (4), the cadmium (Cd) concentration in egg samples was detected in the range between 0.002 ppm (E1) and 0.009 ppm (E2). In all samples were lower than the WHO standard value 0.05 ppm and sample E3 was not detectable in ppm range. Short-term exposure to very high levels of cadmium can cause nausea and muscle cramps, sensory disturbance, liver injury. Long-term exposure to very high levels of cadmium can cause kidney damage, liver damage and bone damage and then blood damage. Cadmium and cadmium compounds are known as human carcinogens.

In figure (5), the iron (Fe) concentration in egg samples was found in the range between 0.941 ppm (E2) and 7.802 ppm (E3). In all samples were lower than the WHO standard value 44 ppm. Iron (Fe) is essential element in human nutrition. Iron is a dietary requirement for human being. The body absorbs approximately 25% of all iron present in food. Iron is a central component of haemoglobin.

In figure (6), the concentration of lead (Pb) in egg samples was detected in the amount between 0.088 ppm (E3) and 0.349 ppm (E1). In all samples, the concentration of lead was found lower than WHO standard 0.5 ppm and sample E2 was not detectable in ppm range. Lead can accumulate in human body over sometime and cause serious damage to brain, kidney, nervous and red blood cells. Exposure to lead is very dangerous for young children compared to an adult.

In figure (7), the concentration of arsenic (As) in the egg samples were detected in the range between 0.01 ppm and 0.076 ppm. In samples E1 was lower than the WHO standard and samples E2 was a little bit higher than the WHO standard value 0.05 ppm. Contaminated food preparation and irrigation of food crops poses the greatest threat to public health from arsenic.

Table (1). Cadmium, Iron, Lead and Arsenic concentration contained in the egg samples.

Element	E1 (ppm)	E2 (ppm)	E3 (ppm)	WHO (ppm)
Cadmium (Cd)	0.002	0.009	ND	0.05
Iron (Fe)	1.137	0.941	7.802	44
Lead (Pb)	0.349	ND	0.088	0.5
Arsenic (As)	0.01	0.076	0	0.05

ND = Non detectable in ppm range.
E1 = Hen egg in battery farm from Yatsauk.
E2 = Hen egg in poultry farm from Yatsauk.
E3 = Hen egg in battery farm from Nyaung Shwe.

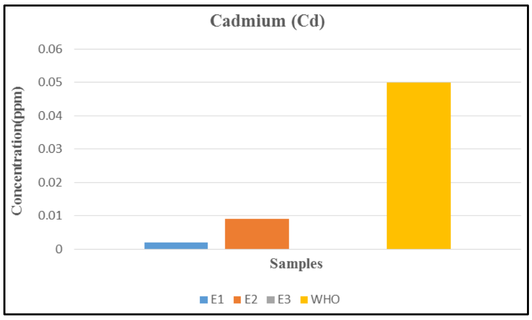

Figure (4). Comparison of Cadmium (Cd) concentration in experimental results of hen's eggs and WHO standard level.

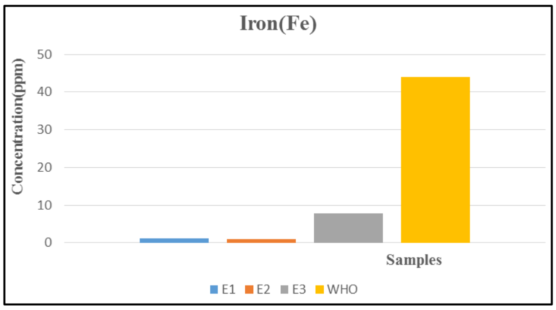

Figure (5). Comparison of Iron (Fe) concentration in experimental results of hen's eggs and WHO standard level.

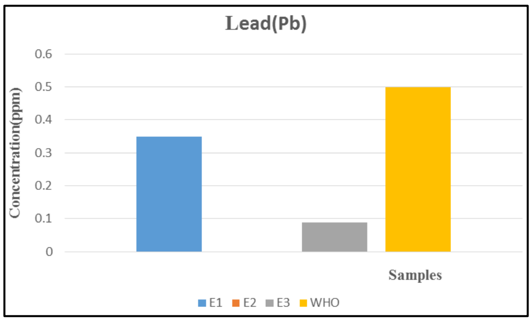

Figure (6). Comparison of Lead (Pb) concentration in experimental results of hen's eggs and WHO standard level.

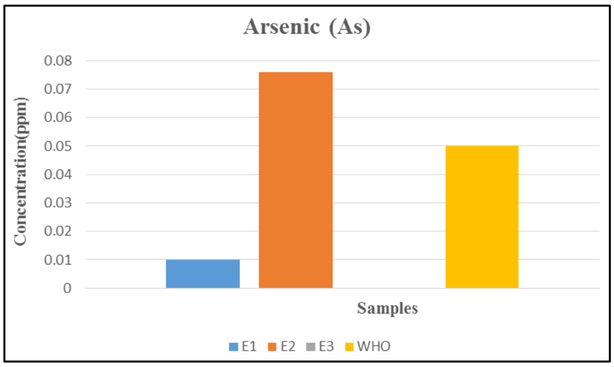

Figure (7). Comparison of Arsenic (As) concentration in experimental results of hen's eggs and WHO standard level.

Table (2) showed the elemental concentration contained in hen's drinking water samples. Figure 8 to 9 showed the comparison of cadmium (Cd) and iron (Fe) concentration in experimental results of hen's drinking water samples and WHO standard level.

Table (2) Cadmium, Iron, Lead and Arsenic concentration contained in the drinking water of hen.

Element	Yatsauk water (ppm)	Naung Shwe water (ppm)	WHO Standard (ppm)
Cadmium (Cd)	0.0467	ND	0.003
Iron (Fe)	0.0324	0.0556	0.3
Lead (Pb)	ND	ND	0.015
Arsenic (As)	ND	ND	0.01

ND = Non detectable in ppm range.

According to the AAS results, in figure (8) showed the comparison of Cadmium (Cd) concentration in experimental results of drinking water of hen samples and WHO standard level, drinking water of hen from Yatsauk was higher than WHO standard level.

In figure (9) showed the comparison of Iron (Fe) concentration in experimental results of drinking water of hen samples and WHO standard level, in all samples were lower than WHO standard level. In all samples, concentration of lead (Pb) and arsenic (As) were not detectable in ppm range.

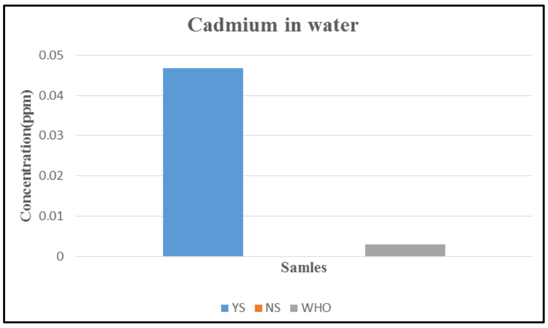

Figure (8). Comparison of Cadmium (Cd) concentration in experimental results of hen's drinking water samples and WHO standard level.

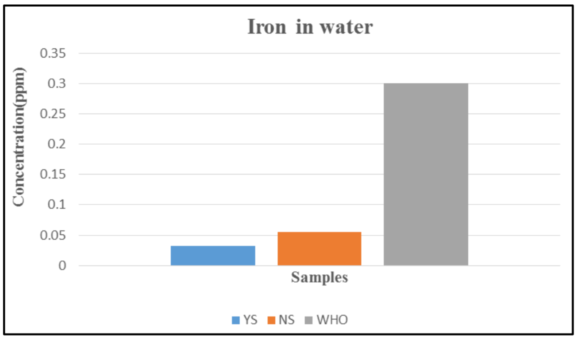

Figure (9). Comparison of Iron (Fe) concentration in experimental results of hen's drinking water samples and WHO standard level.

Conclusion

The study was done for concentration of heavy metals cadmium (Cd), iron (Fe), lead (Pb) and arsenic (As) in hen's eggs and drinking water of hen. Among the heavy metals in three samples studied, Lead (Pb) concentration is highest in sample E1 and arsenic (As) concentration is highest in sample E2. Lead has no beneficial biological function and is known to accumulate in the body. Lead exposure can adverse health effect, especially in young children and pregnant women. Concentration of cadmium (Cd) in drinking water of hen is more than that of WHO standard. But the concentration of cadmium (Cd) in egg samples is less than that of WHO standard. So, samples E1 and E3 are better than sample E2 because sample E2 is exceed the maximum permissible limit of arsenic (As).

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