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HEAVY METALS LEAD AND CADMIUM CONCENTRATION OF FRESH MALLARD DUCK EGGS FROM KAPATAGAN, LANAO DEL NORTE, PHILIPPINES

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ABSTRACT

The study was conducted to determine the concentration of heavy metals lead and cadmium on Mallard duck eggs from Kapatagan, Lanao del Norte Philippines. Following the Complete Randomized Design (CRD) a total of 90 fresh mallard duck eggs were randomly collected from 3 duck farms of Kapatagan, Lanao del Norte. Fresh duck eggs were cleaned and cracked carefully to completely separate the egg yolk and egg white, placed in a separate plastic containers, labeled and transported directly to FAST laboratory for analysis. The analysis of heavy metals lead and cadmium were performed using Atomic Absorption Spectrophotometer (AAS). Results revelaed that fresh mallard duck egg yolks have significanty higher concentration of lead, higher than the recommended level of 0.43 mg/kg. The egg white samples from farm 2 have higher lead concentration than the samples collected from farm 1 and farm 3. Cadmium concentration in all egg yolk and egg white samples were at ≤0.02 mg/kg. Based on the presented results it is thereby concluded that fresh mallard duck eggs from Kapatagan, Lanao del Norte is not already safe for human consumption.

Keywords: Lead, cadmium, mallard ducks, egg yolk and egg white

1. INTRODUCTION

In the Philippines, duck egg production is one of the major sources of livelihood of Filipino Families. Duck egg is a typical food for Filipinos. It is customarily eaten as a main dish like salted egg, as a snack food such as “balut” and “penoy” and as ingredient in Filipino cookery such as “puto-pao” and bibingka. it is the second most widely consumed in the Filipino diet with mean per capita intake of almost one-half kg per year (Bureau of Agricultural Statistics, 2011).

In Northern Mindanao and nearby provinces, the municipality of Kapatagan, Lanao del Norte is one of the most known sources for fresh duck eggs for the production of balut (patially hatched embryo). Mallard duck production became popular in this place because it provides good income to farmers. Conventionally, ducks are grazed on farms during off rice season to save the cost of

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feeding. However, this type of feeding may easily influence the direct assimilation of variuos pollutants which may then affect ducks productivity.

According to Molina et al., (2009) fertilizers and some pesticides (Habib et al. 2012) can increase the concentration of some metals in soil and plants. On the other hand, irrigation water also affects soil metal levels depending on metal concentrations of water and irrigation intensity. Since mallard ducks in Kapatagan are grazed on an open rice fields the need to determine the concentration of heavy metals lead and cadmium on duck eggs are highly advisable. Thus, the current study was conducted to evaluate the concentration of heavy metals lead and cadmium from fresh duck eggs in selected duck farms of Kapatagan, Lala, Lanao del Norte. The result of this study will serve as a baseline information on the current status of heavy metals contamination from fresh duck eggs. Moreover, this will also provide valuable information to all consumers on the safe consumption of fresh duck eggs and flavored duck egg products.

2. MATERIALS & METHODS

Sample Collection

Ninety fresh duck eggs were randomly collected last March 9, 2018 from the three famous mallard duck farms of kapatagan, Lanao del Norte. Fresh egg samples were properly cleaned using wet rags to remove dirts and other debris that may affect the result. After which, each egg sample was carefully cracked to separate completely the egg white and egg yolk. The obtained egg white and egg yolk samples were placed separately in a clean plastic containers, labeled and transforted to FAST Laboratory for analysis of lead (Ld) and cadmium (Cd) concentration.

Chemical Analysis

At FAST laboratory center samples were subjected to acid digestion following the method described by Jeng and Yang (1995). One gram of each sample (egg white and egg yolk) was placed in 100 ml digestion flask and then 10 ml of concentrated nitric acid (65%) was added. The flask was heated for 20 minutes. The sample was cooled at room temperature then, 5 ml perchloric acid was added. After which, the sample was heated vigorously until a clear solution was obtained. The content of the flask were filtered using a 50 ml volumetric flask and was made up to the mark with distilled water (Akan et al., 2010).

Heavy metals lead and cadmium in samples were analyzed directly from each of the final solutions using Atomic Absorption Spectroscopy (AAS).

Statistical Analysis

All data gathered were processed and analyzed by Analysis of Variance (ANOVA) using SPSS version 20 with homogeneity of variance tested using Lavene's test. The significant differences among treatment means were also analyzed using Least Significant Difference (LSD).

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3. RESULTS AND DISCUSSION

The concentration of heavy metals lead and Cadmium from egg yolk and egg white samples are presented in Table 1. Results revealed that concentration of lead found in egg yolk and egg white samples from the selected farms varied. However, based on statistical analysis the slight variations observed among treatments showed no significant differences.

Table 1. Lead and Cadmium content of egg white and egg yolk samples from fresh mallard duck eggs of Kapatgan, LDN

Treatments	LEAD		CADMIUM	
	Egg White	Egg yolk	Egg White	Egg yolk
T1R1	0.26	0.60	0.02	≤0.01
T1R2	0.45	0.62	0.01	0.01
T1R3	0.38	0.57	≤0.01	0.01
T1R4	0.51	0.69	≤0.01	≤0.01
T1R5	0.44	0.69	≤0.01	0.01
Mean	**0.41**	**0.634**	**≤0.01**	**0.01**
T2R1	0.95	0.48	≤0.01	≤ 0.01
T2R2	0.29	0.51	≤0.01	≤0.01
T2R3	0.51	0.51	0.02	≤0.01
T2R4	0.51	0.67	0.02	≤0.01
T2R5	0.54	0.81	0.02	≤0.01
Mean	**0.56**	**0.60**	**0.02**	**≤0.01**
T3R1	0.18	0.33	0.02	≤ 0.01
T3R2	0.33	0.47	0.02	≤ 0.01
T3R3	0.32	0.54	0.01	≤ 0.01
T3R4	0.44	0.53	0.02	≤0.01
T3R5	0.39	0.60	0.02	≤0.01
Mean	**0.33**	**0.50**	**0.03**	**≤0.01**

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From the data presented in Table 1 egg white samples from farm 2 obtained higher lead concentration with a mean of 0.56 mg/kg compared to farm 1 and 3 with 0.41 and 0.33 mg/kg. All egg yolk samples collected from the 3 selected farms also showed higher lead residue with a mean 0.64 , 0.60, and 0.50 mg/kg, respectively. The high concentration of lead found from egg yolk and egg white samples from fresh mallard duck eggs could be linked to the direct assimilation of ducks on contaminated feeds and water. Farmers in this area are reliant to inorganic fertilizer and pesticides application every cropping to obtain high rice yields. These practices enhance soil acidity and promotes the retention of lead into the soil, water, and crops. When ducks are grazed in the rice field it will directly ingest the contaminated water, crops, including snails. Once heavy metals are absorbed, they are deposited in the bones, muscles, liver, kidney, and eggs even throughout the life (Bernard, 2008). According to Pain Manninen & Tansakanan et al., (1993) lead particles can dissolve in soil water and can be assimilated by plants, generating alterations when the concentration exceeds certain limits, or can affect the herbivorous animals that consume them. Molina et al., (2009) and Habib et al., (2012) also stated that fertilizers and some pesticides can increase the concentration of some metals in soil and plants. Irrigation water on the other hand, affects soil metal levels depending on metal concentrations of water and irrigation intensity.

The finding of the present study confirms to the result reported by Trampel et al., (2003) who observed high level of lead contamination in hen egg yolk compared to albumin. Recently, Aendo et al., 2016 reported that lead and cadmium contamination was found in duck commercial feeds and self-mixed feeds in small scale farms (<5,000 animals). The contamination level of lead and cadmium were 1.32±0.91 ppm and 3.19±0.12 ppm and 0.12±0.08 ppm and 0.28±0.05 ppm in commercial and self-mixed feed, respectively, even though the contamination of both metals were not higher than the standard limits of NRC (National Research Council,1980). Trampel (2003) also reported a higher concentration of lead on egg yolk along with the increase concentration of lead in the blood of chicken fed with different levels of lead. Furthermore, Aendo, (2016) in the same conducted study found that lead contamination in duck egg from free-ranging farm was correlated with lead levels in water at $r2 = 0.806$ ($p< 0.05$), whereas lead contamination in duck egg from small scale farm was correlated with lead found in feeds at $r2 = 0.862$ ($p< 0.05$).

On the other hand, lower concentration of cadmium at 0.02 mg/kg was found in all egg yolk and egg white samples (Table 1). The results showed that fresh duck eggs from Kapatagan, Lanao del Norte were free from Cd contamination. This result disagree to the findings of Aendo (2016) who reported high concentration of cadmium in free grazing duck in Thailand. Leach et al., (1979) and Sato et al., (1997) stated that the limited contamination of eggs with cadmium is due to protection of the follicle against cd contamination. Similar result was also reported by Ahmed et al., (2017) on free range chicken eggs.

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Health Risk

The recommended or tolerable level intake of heavy metals lead and cadmium are presented in Table 2.

Table 2. Estimated daily intakes of heavy metals through farm eggs mg/kg

Metal	Requirement/Tolerance level (mg/kg)
Cadmium	0.06-0.07
Copper	10
Chromium	0.05
Lead	0.43
Zinc	77.00

Adopted from Khalid et al. (2007) and Expert Group on Vitamins and Minerals (EVM: 2003).

From above recommended level of intake of lead and cadmium it shows that the concentration of lead found in fresh duck egg yolk samples exceeded within the normal tolerable daily intake. Accoring to Llobet et., (2003) heavy metals can easily enter the food chain and have been reported to have detrimental effects on human body (Hooda et al., 1997). Heavy metals are classifed as potentially toxic (cadmium and lead, etc) (Jalabani et al., 2007). Intake of these heavy metals even at low concentration at long period of time can lead to toxicity. Heavy metals toxicity can lead in the damaged or reduced mental and central nervous system functions, lower energy levels, and damage to blood composition, lungs, kidneys, liver and other vital organs (International Occupational Safety and Health Information., 1999). Some heavy metals are so toxic that a low concentration can adversely effect on a number of metabolic processes in the body (Bernard, 2004; Nordberg et al., 2007). Toxic concentration of heavy metals can cause teratogenic, mutagenic and carcinogenic effects on biological organisms including birds (Hashmi et al., 2013).

CONCLUSION

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Based on the above presented results it is thereby concluded that fresh mallard duck eggs from Kapatagan, Lanao del Norte is not already safe for human consumption.

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