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SOME HEAVY METALS RESIDUES IN FRESH HEN EGGS MARKETED IN ZAGAZIG CITY, EGYPT

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ABSTRACT

Two hundred fresh hen eggs were collected randomly from supermarkets in Zagazig city, Egypt to analyze the contents of lead and cadmium in yolk and albumin. Results revealed that the mean concentrations (range) of lead and cadmium in yolk were 0.350 ppm (0.051 to 0.700) and 0.015 ppm (0.005 to 0.025) respectively. While, the mean concentration (range) of lead in albumin was 0.110 ppm (0.030 to 0.260). Grading of examined whole egg samples according to permissible limits, it was clear that all whole egg samples were within the permissible limit of cadmium, while only one sample (5%) exceeded the permissible limit of lead. The public health hazard of heavy metals was discussed and the preventive measures to produce high quality and safety eggs and also protect the consumers were suggested.

KEYWORDS: Lead, cadmium, yolk, albumin, egg, heavy metals.

ملخص البحث

بقايا بعض المعادن الثقيلة في بيض الدجاج المعروض للبيع بمدينة الزقازيق – مصر

استهدفت هذه الدراسة قياس بقايا بعض المعادن الثقيلة ذات الأهمية الصحية في صفار وبياض بيض الدجاج المعروض للبيع. لهذا الغرض تم تجميع 200 بيضة من البيض المعروض للبيع في السوبرماركت بمدينة الزقازيق – مصر ، وقد تم فصل البياض عن الصفار ومزج كل 10 عينات مع بعضها ثم تجهيزها وتحليلها لتقدير بقايا كل من الكادميوم والرصاص باستخدام جهاز الامتصاص الذرى الطيفي. ولقد أظهرت النتائج أن تركيز كل من الكادميوم والرصاص (جزء في المليون) في صفار البيض تراوحت من 0,005 الى

0,025 (المتوسط 0,015) و 0,051 الى 0,700 (المتوسط 0,350) على التوالي، أما تركيز الرصاص في البياض فتراوح من 0,030 الى 0.26 (المتوسط 0,110) ، بينما لم يتواجد الكادميوم في البياض.

بمقارنة النتائج في كل من الصفار والبياض بالمعدلات المسموح بها دوليا وجد أن عينة واحدة (5٪) من صفار البيض احتوت على الرصاص وقد زادت عن الحد المسموح به. أما بالنسبة لبقايا الكادميوم فكانت كل العينات أقل من الحد المسموح به. وبمقارنة النتائج في البيضة الكاملة للحد المسموح به فقد وجد أن عينة واحدة 5٪ زادت عن الحد المسموح به من الرصاص. ونظراً لخطورة هذه المعادن على الصحة العامة لذا يجب تطبيق برامج سلامة الغذاء في جميع مراحل إنتاج ونقل وتخزين واعداد بيض المائدة وكذلك إجراء فحص دوري منتظم لبقايا المعادن الثقيلة في الغذاء من أجل إنتاج بيض صحى وآمن للحفاظ على صحة وسلامة المستهلك.

INTRODUCTION

Eggs are an important food source as well as a component of many food products consumed throughout the world. Eggs provide a unique, well-balanced source of nutrients for persons of all ages. Eggs are a rich source of protein, essential fatty acids, iron, phosphorous, trace minerals, fat soluble vitamins (A, D, E and K) and many of water soluble B vitamins (Stadelman and Cotterill, 1995). Heavy metals are among the most dangerous pollutants that have tendency to accumulate in the tissues and organs of birds, animals and humans (Antoniou et al., 1989**)**. Laying hens may be exposed to heavy metals from water, feed of plant or animal origin, sprays or dusts applied to them in their environment as well as from chemically treated bedding. The accumulation of persistent heavy metals in the tissues of birds and subsequent excretion via eggs constitute an important recovery pathway for these compounds in the avian species (Abd El-Kader, 1994 and Zrodlewski et al., 1994).

Lead, cadmium and mercury are the most heavy metals of concern which at sufficient levels in food could cause problems to human health (Wojciechowska-Mazurek et al., 1992 and Hassan et al., 2015). There few publications on the heavy metals contamination of egg contents in Egypt. Therefore, this study was planned to throw the light on some heavy metal residues in fresh hen eggs marketed in Zagazig city, Sharkia province, Egypt.

MATERIALS AND METHODS

Sampling:

Two hundred fresh hen eggs were collected randomly from supermarkets in Zagazig city, Sharkia province, Egypt.

The eggs were broken, then the yolk and albumin were separated. Each ten samples of yolk or albumin were pooled and homogenized respectively with an electric mixer, then stored in clean polyethylene bottles at -20ºC until measurement. Yolk and albumin of each sample were weighted to determine the concentration of lead and cadmium.

Estimation of lead and cadmium concentration:

Each sample of egg yolk or albumin was placed into a crucible, then dried at 135ºC for 4 hours. Dried samples were cooled to room temperature and put into Kjeldahl flask. Ten ml of conc. HNO_3 and 5 ml conc. H_2SO_4 were added to each sample and digestion was completed. The digest diluted to 100 ml with deionized water (AOAC, 2000).

Cadmium and lead contents in the diluted samples of yolk and albumin were determined by using Buck Scientific Atomic Absorption Spectrophotometer 210 VGP according to procedures described by Jeng, S.L. and Yang, C.P. (1995, p. 187).

RESULTS

Table 1: Concentration of cadmium and lead residues in examined egg yolk samples (n = 20)

Heavy metals	Contaminated samples		Conc. of heavy metals (ppm)			
	No.	%	Min.	Max.	Mean	S.E.M. ±
Cadmium (Cd)	2	10.0	00.005	0.025	0.015	0.01
Lead (Pb)	3	15.0	0.051	0.700	0.350	0.189

Table 2: Concentration of cadmium and lead residues in examined egg albumin samples (n = 20)

Heavy metals	Contaminated samples		Conc. of heavy metals (ppm)			
	No.	%	Min.	Max.	Mean	S.E.M. ±
Cadmium (Cd)	0	0.0	-	-	-	-
Lead (Pb)	3	15.0	0.030	0.260	0.110	0.075

Table 3: Grading of examined egg yolk samples according to permissible limits set by Zmudzki and Szkoda (1996)

Heavy metals	No. of examined samples	Permissible limits (ppm)	Within permissible limits		Over permissible limits	
			No. of samples	%	No. of samples	%
Cadmium (Cd)	20	0.05	20	100.0	-	-
Lead (Pb)	20	0.5	19	95.0	1	5.0

Table 4: Grading of examined egg albumin samples according to permissible limits set by Zmudzki and Szkoda (1996)

Heavy metals	No. of examined samples	Permissible limits (ppm)	Within permissible limits		Over permissible limits	
			No. of samples	%	No. of samples	%
Cadmium (Cd)	20	0.05	20	100.0	-	-
Lead (Pb)	20	0.50	20	100.0	-	-

Table 5: Grading of examined egg yolk and albumin (whole egg) samples according to permissible limits set by Zmudzki and Szkoda (1996)

Heavy metals	No. of examined samples	Permissible limits (ppm)	Within permissible limits		Over permissible limits	
			No. of samples	%	No. of samples	%
Cadmium (Cd)	20	0.05	20	100.0	-	-
Lead (Pb)	20	0.5	19	95.0	1	5.0

DISCUSSION

The results recorded in Table 1 revealed that the examined yolk samples were contaminated with the both heavy metals (ppm): cadmium from 0.005 to 0.025 and lead from 0.051 to 0.7000. Moreover, lead showed the highest mean value (0.350±0.189 ppm) and cadmium with an average of 0.015±0.01 ppm. Regarding heavy metals detected in the albumin samples, Table 2 revealed that the levels of lead (ppm) were 0.030 to 0.260 with a mean of 0.110±0.075. While, cadmium was not detected in any of the analyzed samples.

Residues of lead and cadmium could be detected in yolk and albumin with different values by authors (Abdel-Kader, 1994; Zrodlewski et al., 1994; Jeng and Yang, 1995; El-Hoshy and Ashoub, 1998; Ahmed, 2002 and Abdel-Fattah, 2002). On the other hand, Siddiqui et al. (2011) failed to detect cadmium in the examined hen eggs collected from local markets of London, UK.

From the results reported in Tables 1 and 2, one can easily conclud that the egg yolks contained more lead than albumin, while cadmium was detected with low levels in the egg yolk samples but could not be detected in the egg albumin samples.

The accumulation of cadmium and lead in egg yolk was higher than that in the egg albumin (as in Doganoc, 1996; Flores and Martins, 1997; Demirulus, 2013 and Islam et al., 2014).

In comparison the present results with the permissible limits set by Zmudzki and Szkoda (1996), it was found that only one sample (5%) of the analyzed egg yolk samples exceeded the permissible limit of lead (0.5 ppm). On the other hand, there was no samples exceeded the permissible limit for cadmium Table 3. Regarding egg albumin, all the examined samples were within the permissible limits of lead and cadmium Table 4.

According to whole egg, Table 5 revealed that all whole egg samples were within the permissible limit of cadmium, while one sample (5%) was exceeding the permissible limit of lead.

Islam et al. (2014) reported that cadmium and lead contaminations in Pakistan edible poultry eggs were 2-3 fold increases than permissible daily intake level. Also, Rania et al. (2016) reported that 34% and 40% of organic eggs samples in Egypt exceeded the maximum permissible limit of cadmium and lead respectively.

Lead, cadmium and mercury are non-essential elements and considered toxic metals due to their competition with the essential metals for binding sites and also there interference with sulphahydral group and structural protein (Dasilva and Williams, 1991).

Chronic lead poisoning results in anaemia, liver dysfunction, muscle pain, nephropathy and neuropathy (Goldfrank et al., 1990).

Exposure to cadmium could occur during the production of phosphate fertilizers since the presence of significant amount of cadmium in crude phosphate (Grandjean, 1986). Cadmium poisoning is reported to cause Itai-Itai disease in human with symptoms largely referable to bone and muscle pain. It also cause growth retardation and testicular damage (Gossel and Bricker, 1990).

On conclusion, the mean concentrations (range) of lead and cadmium in yolk were 0.350 ppm (0.051 to 0.700) and 0.015 ppm (0.005 to 0.025) respectively. While, the mean concentration (range) of lead in albumin was 0.110 ppm (0.030 to 0.260). Grading of examined whole egg samples according to permissible limits, it was clear that all whole egg samples were within the permissible limit of cadmium, while only one sample (5%) exceeded the permissible limit of lead.

presence of various amounts of lead and cadmium in egg yolk and albumins is mainly due to greater pollution of the environment which have resulted in an increasing of these metals in air, water and soil. It is necessary to monitor litters, feed and water to detect the sources of heavy metals contamination. A regular monitoring of heavy metals in hen's eggs is recommended at an appropriate frequency to establish the true contribution of eggs to the dietary intake of heavy metals to avoid adverse toxic effects for human consumption. In addition, Hazard Analysis and Critical Control Point (HACCP) system must be applied during egg production to control egg safety hazards.

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