IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

RISK ASSESSMENT OF LEAD IN CHICKEN MEAT AND EGGS FROM DIFFERENT ENVIRONMENTS OF EGYPT

A.A.K. Abou-Arab*, M.A. Abou Donia, Sherif R. Mohamed, A.K. Enab
* Food Toxicology and Contaminants Dep National Research Centre, 33 Bohouth St. Dokki, Giza, Egypt.Affiliation ID: 60014618.
Food Toxicology and Contaminants Dep National Research Centre, 33 Bohouth St. Dokki, Giza, Egypt.Affiliation ID: 60014618.
Food Toxicology and Contaminants Dep National Research Centre, 33 Bohouth St. Dokki, Giza, Egypt.Affiliation ID: 60014618.
Dairy Dep National Research Centre, 33 Bohouth St. Dokki, Giza, Egypt.
Affiliation ID: 60014618.

ABSTRACT
Chickens are the most common sources of poultry meat (87%) of total poultry production. Heavy metals as lead are widely dispersed in the environment and may causing contamination of foods and health risks to consumers. The present study was to evaluate the concentrations of lead in chicken and eggs in three main areas represent ecosystem in Great Cairo, i.e., industrial, heavy traffic and rural. The highest mean levels of lead in chicken meat were, 3.1029, 2.9203 and 1.8550mg/kg in industrial, traffic and rural areas, respectively. On the other hand, no significant differences ($p \geq 0.05$) were observed between lead levels in chicken meat samples from industrial or traffic areas. Comparing lead levels in the samples collected from the three areas among the two seasons, data proved that the highest mean values of lead in chicken meat were detected during summer season in industrial areas and winter season in traffic and rural areas. Lead levels in chicken eggs samples were also determined. Data proved that the lowest mean lead concentration was found in white (0.1791, 0.1320 and 0.1012mg/kg), followed by yolk (0.3620, 0.3076 and 0.1693mg/kg) and cortex layers (4.0222, 3.0048 and 1.2627mg/kg) in the samples collection from industrial, traffic and rural areas, consequently. It can be recommended that monitoring and evaluation of lead levels in foods at regular intervals and maintaining data base is very important.

KEYWORDS: Heavy metals, Lead, Chicken, Eggs, Environments.

INTRODUCTION
Protein intake is recommended as being in range of 0.8 to 1.6 g per kg body weight for humans (Anonymous, 1998). According to RDA (1989), the daily protein requirements for males over age 25 is 63 g/day. According to the daily animal protein requirement per person is 30 g (Abed EL-Gowde, 1995). Annual animal protein requirement for an average person can be fulfilled by the consumption of altogether 100 eggs, 43.5 kg meat and 90 liters of milk (Hasnath, 2002).

Poultry, or domestic birds, are raised for their meat and eggs and are an important source of edible animal protein. Poultry meat accounts for 30% of global meat consumption. The worldwide average per capita consumption of poultry meat increased from 3 kg in 1963 to 11 kg in 2003 (FAOSTA, 2009). The nutritional benefits of poultry meat are mainly due to the content of high quality proteins and a good source of phosphorus beside other minerals, as well as some types of vitamins as A and B-complex. On the other hand, poultry meat contains less fat than most cuts of beef and pork. It has a higher proportion of unsaturated fatty acids than saturated fatty acids. This fatty acid ratio suggests that poultry may be a more healthful alternative to red meat (FAOSTA, 2009). Chickens are the most common sources of poultry meat (87%) of total poultry production. Poultry meat and eggs are widely available, relatively inexpensive and can be of central importance in helping to meet shortfalls in essential nutrients, particularly of impoverished people (FAOSTA, 2009). For practical and price reasons, eggs are considered the most important animal protein source especially for the low and middle-income households because they are relatively cheap. Also, eggs are source of energy, essential nutrients, amino acids, minerals (phosphorus and iron) and vitamins as A, D, E and K (BELL, 2002).

Heavy metals are widely dispersed in the environment and may causing contamination of foods. Recent years have witnessed significant attention to the problems of heavy metals contamination which have been broadly studied (Abou-Arab et al., 2014; Abou Donia, et. al., 2014; Abou-Arab and Abou Donia, 2002; 2001). The sources of toxic metals as lead in the environment are the fossil fuels, mining industries, waste disposals and municipal sewage. Farming and forestry also contribute to the metal content in the environment due to the uses of fertilizers, pesticides and herbicides. As a consequence of environmental pollution, the contaminants may enter the food chain. So the major route of entry of most metals into the body is through the diet (Chowdhury, et al., 2011). They enter in the human body through food chain causing different diseases and damages to the humans (Tuzen and Soylak, 2007; Yilmaz et al., 2007). Human exposure to toxic heavy metals such as lead is known to be responsible for many human health problems. Contaminated foods are a major source of such heavy metals to man (Ward, 1995). Contamination of food usually takes place during transportation, storage, processing, preparation and environmental conditions. The toxicity of lead is attributed to the fact that it interferes with the normal function of enzymes. Bipolar lead forms strong bonds with enzymes bearing sulfhydryl groups thus inhibiting their action. Lead is toxic to the blood and the nervous, urinary, gastric and genital systems. Furthermore, it is also implicated in causing carcinogenesis, mutagenesis and teratogenesis in experimental animals (Pitot and Dragan, 1996). Accumulation of lead produces damaging effects in the hematopoetical, hematic, renal and gastrointestinal systems (Correia et al., 2000).

Consequently, information about dietary intake is very important to assess risks to human health. To evaluate the health risks to consumers, it is necessary to determine the specific dietary intake of each pollutant for comparison with toxicologically acceptable levels (Leblanc, et al., 2000). Although human bodies have got homeostatic mechanisms that enable them to tolerate small fluctuations in the intake of heavy metals, the intake of such metals above or below certain permissible or recommended levels have devastating acute and chronic health effects (WHO, 1998; 1996 and 1995).

The aim of the present study was to evaluate the concentrations of lead in chicken and eggs, which are commonly consumed as a popular diet in Egypt. Also, the investigation provided information about the concentrations of lead in three main areas represent ecosystem in Great Cairo, i.e., industrial, heavy traffic and rural areas.

MATERIALS AND METHODS

Materials

Chemicals and reagents

Stock standard solution (1000 mg/L) of lead (pb) was purchased from Merck (Merck, Darmstadt, Germany). Concentrated nitric acid at high grade (BDH chemical LTD) was also purchased. De-ionized water from a Milli Q water purification was used.

Chicken meat and eggs samples

A total of 180 chicken meat samples (60 from each area)**,** and 75 eggs samples (each one resulted from mixing of six eggs and 25 from each area) were randomly collected from three main models represent different environments in Great Cairo (Egypt), i.e., industrial (Shoubra El-Kheima and Helwan), heavy traffic (Faysal), and rural areas (near cultivated lands) during the period of 1/5/2010 to 1/11/2012. The numbers collection of chicken meat samples from each area during this period were 5 samples during each period of 1/5/2010 to 26/10/2010, 1/11/2010 to 30/4/2011 and 1/5/2011 to 20/10/2011, 20 samples during the period of 1/11/2011 to 30/4/2012 and 25 samples during the period of 1/5/2012 to 1/11/2012. The samples (3kg meat for each sample) were quite representative since the districts from where foodstuffs were scattered throughout the different environments in Great Cairo, Egypt. Sub-samples (1kg, each) were taken at random from the composite sample and processed for analysis by the dry-ashing method. On the other hand, five eggs samples were collected during each period from each area. Yolk, white and cortex portions of an egg were analyzed separately. Lead contents were determined in all sample parts without any processes as washing.

Methods and Procedures

Test principle

Lead is extracted from different commodities according to the methods of AOAC (2000). A dry ashing method is used for the destruction of organic matter. The ashed samples are dissolved in acidic de-ionized water and lead contents are recorded by atomic absorption spectrophotometer at maximum absorbance obtained at wavelength 217.0 nm from the cathode lamp.

Sample preparation

Different weights of samples are homogenized separately and 3-5 g of the fresh homogenate is weighed into crucibles and dried in an oven at 100-110°C overnight (~16h.). Dried samples are ashed in a muffle furnace at 500-550°C. The ashed samples are cooled to room temperature and dissolved in 1mL 10% (v/v) nitric acid and then completed to a definite volume with de-ionized water.

Determination (Instrumentation)

The sample solutions are subsequently measured for lead as wet weight basis using PG-990 atomic absorption spectrophotometer (PG Instruments LTd) with flame atomization (air-acetylene), equipped with a 10 cm burner and a deuterium lamp for back ground correction. Maximum absorbance obtained by adjusting the cathode lamp at the proper wavelength (217.0 nm). The other analytical parameters were; bandwidth, 0.4 nm; filter factor, 1.0; lamp current, 5.0 ma; integration time, 3.0 sec; background, D2/SR and flame setting, oxidizing blue.

Method's validity

Quality assurance

Quality assurance procedures and precautions carried out to ensure reliability of the results. All materials used for processing screened for possible lead contamination. Acidic-cleaned volumetric flasks and other glassware socked in a soapy solution (2% solution isoclean detergent) for 24hr., then rinsed and soaked in 10-15% nitric acid for 48hr., then rinsed with ultrapure water and dried under clean conditions. De-ionized water used throughout the study. The samples were generally carefully handled to avoid contamination.

Recovery and Detection Limit

Recovery results refer to complete method as reported before with different concentrations (0.1, 0.2 and 0.4mg/kg) of lead in chicken meat and eggs. The recovery of lead in fortified meat samples were ranged between (91.0 to 93.0%). However, the recovery of lead in fortified egg samples were ranged between (98.0 to 99.5%). Detection limit of lead was calculated and recorded which was 0.012 mg/L with sensitivity of 0.08 mg/L.

Statistical analysis

The data obtained from this study was statistically subjected to analysis of variance (ANOVA) and means separation was by Snedecor and Cochran (1980). The least significant difference (L.S.D) value was used to determine significant differences between means and to separate means at $p \leq 0.05$ using SPSS package version 15.0.

RESULTS AND DICUSSION

RESULTS

Monitoring of lead levels in Egyptian Chicken meat

Lead levels in chicken meat samples which collected from industrial, traffic and rural areas were determined and data presented in Table 1. Results indicated that lead concentrations in different samples are quite variable among the collected samples from industrial and traffic areas compared with rural areas. These results were confirmed by statistical analysis. On the other hand, no significant differences ($p \geq 0.05$) observed between lead levels in chicken meat samples from industrial and traffic areas. The highest mean levels of lead were, 3.1029 (ranged between 0.3010 to 7.1122) and 2.9203 (ranged between 0.6320 to 6.8201) mg/kg in industrial and traffic areas, respectively. Regarding to the rural areas samples, data indicated that mean lead level was 1.8550 (ranged between 0.1150 to 5.0112) mg/kg.

Table 1. Lead contents (mg/kg) in chicken meat samples from industrial, traffic and rural areas collected during the period of 1/5/2010 to 1/11/ 2012.

Areas	Concentrations (mg/kg)	
	Mean± SD	Range
Industrial	$3.1029^{a} \pm 0.03$	0.3010 - 7.1122
Traffic	$2.9203^{a} \pm 0.03$	0.6320 - 6.8201

Rural	1.8550^{b} ± 0.05	0.1150 - 5.0112
LSD at 5%	0.45	-

-All values are means of 60 determination samples ± standard deviation (SD).
-Means within rows with different letters are significantly different ($p \leq 0.05$)

Lead levels in chicken meat were determined among five periods of samples collection during the period of 1/5/2010 to 1/11/2012 (about 6 months in each period). Data in Table 2 proved that the highest mean levels of lead in the samples were detected in the three areas, (3.6296 mg/kg & 2.6653 mg/kg) in industrial and rural areas during the period of 1/5/2012 to 1/11/2012, and in traffic areas (3.3413 mg/kg) from 1/5/2011 to 20/10/2011. Analysis of variance indicated that insignificant differences ($p \geq 0.05$) were detected between lead levels in the samples collected from industrial areas during the periods of 1/11/2010 to 30/4/2011 & 1/5/2012 to 1/11/2012 and 1/5/2011 to 20/10/2011 & 1/11/2011 to 30/4/2012; and from traffic areas during the periods of (1/11/2010 to 30/4/2011 & 1/5/2011 to 20/10/2011 & 1/11/2011 to 30/4/2012), as well as, the samples from rural areas during the periods of (1/11/2010 to 30/4/2011 & 1/5/2011 to 20/10/2011.

Table 2. Mean lead contents (mg/kg) in chicken meat samples collected from industrial, traffic and rural areas during the periods from 1/5/2010 to 1/11/ 2012.

Areas	**Mean concentrations (mg/kg) ± SD**					**LSD at 5%**
	1	**2**	**3**	**4**	**5**	
Industrial	2.1174^{c}±0.10	3.14102^{a}±0.15	2.7493^{b}±0.15	2.7590^{b}±0.04	3.6296^{a}±0.04	0.72
Traffic	1.306^{c}±0. 0.10	3.2626^{a}±0.15	3.3413^{a}±0.20	3.0930^{a}±0.05	2.9523^{b}±0.04	0.79
Rural	0.283^{c}±0.05	1.027^{b}±0.10	0.9200^{b}±0.10	1.6758^{ab}±0.02	2.6653^{a}±0.04	0.36

-Means within columns with different letters are significantly different ($p \leq 0.05$)
1-1/5/2010 to 26/10/2010 **2**- 1/11/2010 to 30/4/2011 **3**- 1/5/2011 to 20/10/2011
4-1/11/2011 to 30/4/2012 **5**-1/5/2012 to 1/11/2012

The previous periods of samples collection were in summer and winter seasons. Comparing lead levels in the samples collection from the three areas among the two seasons (Table 3), data proved that the highest mean values of lead in chicken meat from the industrial areas were detected during summer season, which recorded 3.2878mg/kg. While the highest mean levels of lead in the samples collection from traffic and rural areas were detected in winter season, which recorded 3.1270 and 1.5460mg/kg, respectively. Analysis of variance indicated that significant differences ($p \leq 0.05$) between the samples collection from the three areas during summer and winter seasons were detected.

Table 3. Mean lead contents (mg/kg) in Chicken meat samples collected from industrial, traffic and rural areas during summer and winter periods.

Areas	**Mean concentrations (mg/kg) ±SD**		**LSD at 5%**
	Summer	**Winter**	
Industrial	3.2878^{a}±0.07	2.8354^{b}±0.03	-
Traffic	2.7727^{b}±0.03	3.1270^{a}±0.03	0.61
Rural	1.3177^{b}±0.03	1.5460^{a}±0.03	0.39

-Means within columns with different letters are significantly different ($p \leq 0.05$)

Monitoring of lead levels in Egyptian chicken eggs

Lead levels in chicken eggs samples which collected from industrial, traffic and rural areas were determined (Table 4). Data indicated that lead concentrations in different eggs portions (yolk, white and cortex) are quite variable among the collected samples from the three areas. Data proved that the lowest mean lead concentrations were found in white (0.1791, 0.1320 and 0.1012 mg/kg), followed by yolk (0.3620, 0.3076 and 0.1693 mg/kg) in the samples from industrial, traffic and rural areas, alternately. On the other hand, the highest lead levels were detected in cortex layer, which recorded 4.0222, 3.0048 and 1.2627 mg/kg in the samples collection from industrial, traffic and rural areas, respectively. Analysis of variance revealed that highly significant differences ($p \leq 0.05$) of lead contents were observed between the concentration of lead in different samples from industrial or traffic areas compared with rural areas. Regarding to eggs (sum of three portions) samples, data indicated that the highest mean lead level was detected in the samples collection from industrial (4.7118), followed by traffic (3.606) and from rural (1.4931 mg/kg) areas. These results confirmed by statistical analysis, which highly significant differences ($p \leq 0.05$) were observed between the three areas.

Lead levels in eggs portions were determined among five periods of samples collection during the period of 1/5/2010 to 1/11/2012 (about 6 months in each period). Data proved that the highest mean levels of lead in the samples from industrial (6.6770 mg/kg) and traffic (5.0363 mg/kg) areas were detected in the period of 1/11/2011 to 30/4/2012 (Table 5). In addition, the highest mean levels of lead in yolk, white and cortex were also detected in the same period from the two areas, which recorded 0.7221, 0.3188 and 5.6361 mg/kg, respectively in the samples from industrial areas; 0.5621, 0.1738 and 4.3004 mg/kg, respectively in the samples from traffic areas. However, the highest mean value of lead in eggs samples from rural areas (2.3217mg/kg) was observed in the period of 1/5/2012 to 1/11/2012. The highest mean values of lead in yolk (0.3382 mg/kg), white (0.7444 mg/kg) and cortex (2.0301 mg/kg) were detected in the period of 1/11/2011 to 30/4/2012, 1/5/2010 to 26/10/2010 and 1/5/2012 to 1/11/2012, in this order. Analysis of variance indicated that significant differences ($p \leq 0.05$) were observed between lead contents in the most periods of samples collection from the three areas. On the other hand, no significant differences ($p \geq 0.05$) were detected between lead levels in the period of 1/5/2011 to 20/10/2011 and 1/5/2012 to 1/11/2012 in the samples of industrial areas; all the periods except the period of 1/11/2011 to 30/4/2012 in traffic samples and 1/11/2010 to 30/4/2011 and 1/11/2011 to 30/4/2012 as well as 1/5/2010 to 26/10/2010 and 1/5/2011 to 20/10/2011 in the samples of rural areas.

The previous periods of samples collection were in summer and winter seasons. Comparing lead levels in the samples collection from the three areas among the two seasons (Table 6), data proved that the highest mean values of lead in chicken meat collected from industrial areas were found in winter season (4.0280 mg/kg). However, the highest mean lead levels in the samples from traffic and rural areas were detected during summer season, which recorded 3.6966 and 1.3851 mg/kg, respectively. Analysis of variance proved that significant differences ($p \leq 0.05$) between the samples collection from the three areas during summer and winter seasons were detected. Regarding to eggs portions from industrial areas, lead levels in yolk, white and cortex were 0.2935, 0.1612 and 3.8237 mg/kg, respectively in summer and 0.3098, 0.1426 and 3.5756 mg/kg, respectively in winter. The corresponding values in the samples from traffic areas were 0.2063, 0.1225 and 3.0872 mg/kg in summer and 0.2393, 0.0975 and 2.4850 mg/kg in winter as well as in the samples from rural areas were 0.1271, 0.0753 and 1.1727 mg/kg in summer and 0.1550, 0.1532 and 0.8550 mg/kg in winter.

Table 4. Lead contents (mg/kg) in eggs portion samples from industrial, traffic and rural areas collected during the period of 1/5/2010 to 1/11/ 2012.

Egg portions	Concentrations in egg portions (mg/kg)						LSD at 5%
	Industrial areas		Traffic areas		Rural areas		
	Mean ±SD	Range	Mean ±SD	Range	Mean ±SD	Range	
Yolk	0.3620^{a}±0.03	0.1206-0.9935	0.3076^{a}±0.02	0.1201-0.8444	0.1693^{b}±0.02	0.0366- 0.7700	0.13
White	0.1791^{a}±0.02	0.0464-0.4787	0.1320^{b}±0.02	0.0889-0.2429	0.1012^{b}±0.02	0.0198-0.2490	0.11
Cortex	4.0222^{a}±0.05	0.4127-7.2322	3.0048^{b}±0.03	1.8242-6.9628	1.2627^{c}±0.02	0.1493-2.0633	0.70
Total	4.7118^{a}±0.06	2.2440-8.5630	3.606^{b}±0.04	2.1480-7.2440	1.4931^{c}±0.68	0.3490-2.4051	0.68

-All values are means of samples number determinations from each area ± standard deviation (SD)
-Means within columns with different letters are significantly different ($p \leq 0.05$

Table 5. Mean lead contents (mg/kg) in chicken eggs portions samples from industrial, traffic and rural areas during the periods of (1/5/2010 to 1/11/ 2012).

Areas	Mean concentrations (mg/kg) ± SD					LSD at 5%
	1	2	3	4	5	
Industrial						
-yolk	0.2179^{c}±0.02	0.2071^{c}±0.02	0.2315^{c}±0.02	0.7221^{a}±0.02	0.4311^{a}±0.02	0.17
-White	0.1799^{b}±0.02	0.1091^{b}±0.03	0.1534^{b}±0.02	0.3188^{a}±0.02	0.1504^{b}±0.02	0.12
-Cortex	2.1470^{c}±0.03	5.0907^{a}±0.03	3.7430^{b}±0.02	5.6361^{a}±0.03	3.4941^{b}±0.02	1.31
-Total	3.2878^{c}±0.04	5.4070^{ab}±0.03	4.1079^{bc}±0.04	6.6770^{a}±0.06	4.0756^{bc}±0.3	1.40
Traffic						
-yolk	0.1634^{bc}±0.02	0.1564^{bc}±0.02	0.1495^{c}±0.02	0.5621^{a}±0.03	0.3065^{b}±0.02	0.15
-White	0.1229^{a} ±0.02	0.1188^{a} ±0.02	0.1057^{a} ±0.02	0.1738^{a} ±0.02	0.1387^{a} ±0.02	-
-Cortex	3.6967^{c}±0.04	3.1545^{c}±0.02	2.8028^{b}±0.02	4.3004^{a}±0.03	3.0696^{c}±0.02	1.29
-Total	3.9830^{b}±0.02	3.4296^{b}±0.03	3.0705^{b}±0.02	5.0363^{a}±0.03	3.5148^{b}±0.04	1.32
Rural						
-yolk	0.1069^{b}±0.02	0.1269^{b}±0.02	0.0825^{b}±0.02	0.3382^{a}±0.02	0.1919^{ab}±0.02	0.16
-White	0.7444^{b}±0.02	0.0917^{b}±0.02	0.0518^{b}±0.02	0.1886^{a}±0.02	0.0996^{b}±0.02	0.06
-Cortex	0.6725^{c}±0.02	1.4598^{b}±0.02	0.8456^{c}±0.02	1.1054^{bc}±0.02	2.0301^{a}±0.02	0.49
-Total	0.8538^{c}±0.02	1.6784^{b}±0.03	0.9799^{c}±0.03	1.6316^{b}±0.04	2.3217^{a}±0.02	0.56

-All values are means of samples number determinations in each period from each area ± standard deviation (SD).
-Means within columns with different letters are significantly different ($p \leq 0.05$).

1-1/5/2010 to 26/10/2010 **2**- 1/11/2010 to 30/4/2011 **3**- 1/5/2011 to 20/10/2011
4-1/11/2011 to 30/4/2012 **5**-1/5/2012 to 1/11/2012

Table 6. Mean lead contents (mg/kg) in chicken eggs portions samples from industrial, traffic and rural areas during summer and winter collection.

Areas	Mean concentrations (mg/kg) ±SD		LSD at 5%
	Summer	Winter	
Industrial			
Yolk	$0.2935^{a}\pm0.02$	$0.3098^{a}\pm0.02$	-
White	$0.1612^{a}\pm0.02$	$0.1426^{a}\pm0.02$	-
Cortex	$3.0872^{a}\pm0.02$	$3.5756^{a}\pm0.02$	-
Total*	$3.8237^{b}\pm0.03$	$4.0280^{a}\pm0.04$	0.61
Traffic			
Yolk	$0.2063^{a}\pm0.02$	$0.2393^{a}\pm0.02$	-
White	$0.1225^{a}\pm0.02$	$0.0975^{a}\pm0.02$	-
Cortex	$3.1897^{a}\pm0.02$	$2.4850^{b}\pm0.02$	1.10
Total*	$3.6966^{a}\pm0.03$	$2.8220^{b}\pm0.02$	0.61
Rural			
Yolk	$0.1271^{a}\pm0.02$	$0.1550^{a}\pm0.02$	-
White	$0.0753^{b}\pm0.02$	$0.1532^{a}\pm0.02$	-
Cortex	$1.1727^{a}\pm0.02$	$0.8550^{b}\pm0.02$	0.86
Total*	$1.3851^{a}\pm0.02$	$1.1033^{a}\pm0.02$	-

-All values are means of samples number determinations in each season from each area ± standard deviation (SD).
-Means within columns with different letters are significantly different ($p \leq 0.05$).

DISCUSSION

Contamination of aquatic systems by heavy metals has become a global problem. Heavy metals as lead may enter aquatic systems from different natural and anthropogenic (human activities) sources, including industrial or domestic wastewater, application of pesticides and inorganic fertilizers, storm runoff, leaching from landfills, shipping and harbour activities, geological weathering of the earth crust and atmospheric deposition (Yilmaz, 2009). They enter in the human body through food chain causing different diseases and damages to the humans (Abou-Arab *et al*., 2014; Abou Donia, *et. al*., 2014;Tuzen and Soylak, 2007; Yilmaz *et al*., 2007). Contamination of food usually takes place during transportation, storage, processing, preparation and environmental conditions.

With respect to chicken meat, results indicated high levels of lead in the samples from the three studied areas. The highest level of lead was detected in the samples from industrial areas followed by heavy traffic and rural areas. The concentration of Pb in this study exceeded the WHO (2007) of 0.2 mg/kg. The lead levels of the present investigation were far higher than those levels recorded by Abou-Arab and Abou Donia (2002).They reported that mean lead level in chicken meat from Great Cairo Governorate was 0.011µg/g. Also higher than those reported by Tahvonen and Kumpulainen (1994) who detected lead in chicken leg meat from Finland at concentration of 5µg/kg. On the other hand, Vos *et al.* (1990) found low lead concentration, mainly <10µg/kg in the Netherlands. In Canada, the concentration of lead in chicken was 8.8µg/kg (Dabcka and McKenzic, 1992). In Nigeria chicken meat was analyzed by Nicolas, *et al*., (2012) for lead level determination. They reported that lead concentration was 0.215µg/g. The measured lead content (0.026µg/g) in chicken samples from Riyadh City, Saudi Arabia was determined by Al Othman (2010). On the other side, lead levels in the present investigation was lower than those recorded by Chowdhury *et al*., (2011) who reported that mean lead concentration in chicken wing was 3.94 mg/kg in the samples from Chittagong city area, Bangladesh.

Regarding to chicken eggs samples collected from Riyadh City, Saudi Arabia lead concentration recorded 0.074µg/g (Al Othman, 2010). Fakayode and Olu-Owolabi (2003) studied levels of metals in chicken eggs from Nigeria**,** the average concentration of Pb was 0.59µg/g. Khan and Naeem (2006) investigated elemental composition of chicken eggs from Pakistan, the average concentrations of Pb ranged between 0.52-0.63µg/g. On the other hand, Abdulkhaliq, *et al*., *(2012), reported that* lead concentrations in hen's eggs ranged between 0.06-0.48µg/g.

From this comparison, lead levels in the collected chicken meat samples in the present study are high. The high concentration of lead in the muscle indicates long term bioaccumulation. Also, high levels of lead may be due to the contaminated feeds and exposed to contaminated atmosphere from industrial or heavy traffic areas. The sources of toxic metals in the environment are the fossil fuels, mining industries, waste disposals and municipal sewage. Farming and forestry also contribute to the metal content in the environment due to the uses of fertilizer, pesticide and herbicides. As a consequence of environmental pollution, the contaminants may enter the food chain (Yilmaz, 2009; Abou-Arab, *et al*. 2008; Abou-Arab and Abou Donia, 2002; 2001) causing different diseases and damages to the humans (Tuzen and Soylak, 2007; Yilmaz *et al*., 2007).Contamination of food usually takes place during transportation, storage, processing, preparation and environmental conditions.

In the present study, data proved that lead levels were variable during the different periods of samples collection and the two seasons (summer and winter). This variation may be depending on regional differences and feeding. In addition, the obtained results confirmed that lead concentrations not stable in the atmosphere. The environmental contamination by lead in different areas leads to the contamination of foods at variable levels due to the seasonal variation. The seasonal mean variation of lead concentrations in the atmospheric city centre of Cairo and Dokki areas during the period from winter (1998) up to winter (1999) were studied by Rizk and Khoder **(**2001). It reveals that the maximum mean concentrations of lead were 2200 and 1700 ng/m^3 in winter, while the minimum were 1300 and 1100 ng/m^3 during the summer season at the city centre and Dokki sites, respectively. These levels decreased to 455ng/m^3 in summer and 664ng/ m^3 in winter during the period of 2001 and 2002 in the atmosphere Faysal area (Shakour *et al*., 2006).The seasonal variations of lead concentrations may occur under the effect of seasonal meteorological variations. The temperature inversion layers within the atmosphere are more persistent in winter than in summer for producing the seasonal variations of lead concentrations (Shakour *et al*., 2006). Although atmospheric lead originates from a number of industrial sources, leaded gasoline appears to be a principal source of general environmental leaded pollution (Rizk and Khoder, 2001).Tetraethyl lead was introduced as an antiknock agent in gasoline in the 1920s (EPA, 1986). And since then has played an increasingly important role as a pollutant of the general atmosphere. In the present investigation samples were collected from the residential area of Faysal which characterized by heavy traffic, many new buildings under construction and unpaired roads. It also located south west the city center of Cairo City, so the main source of lead was the heavy traffic emission and that transported by winds from the city centre. Atmospheric lead concentration differs from one country to another. It depends on motor vehicle density and efficiency of efforts to reduce the lead content of gasoline (WHO, 1987 and 1989). It has been estimated that vehicles contribute 80-96% of all lead emissions to the atmosphere (Moriber, 1979). It has been shown that 70-80% of the lead intake to the motor is expelled to the atmosphere whereas the remaining 20-30% accumulates in the exhaust system and in the lubricating oil (Turk *et al*., 1973). Recently, the government of Egypt introduced measures to reduce the lead concentration in the environment. These include the use of natural gas as fuel in houses and in some vehicles, as well as, the establishment of a long net underground metro in Cairo City. Beginning from the year 1991, the Egyptian authorities reduced significantly the lead content of gasoline sold in Cairo, where the lead problem had been the most serious. It was planned that in a five-year period by 1996, the gasoline sold must be completely unleaded (Rizk and Khoder, 2001). The future population exposure to air**,** lead is expected to fall further. However, concentrations of lead in different food items including are expected to remain at the present level if produced grown in contaminated areas.

CONCLUSION AND RECOMMENDATION

It could be concluded that lead levels in chicken meat and eggs are relatively high. The concentrations of lead in different samples from industrial and traffic areas are much higher as compared to those from rural areas. The elevated levels of lead in the people bodies may result in various health and developmental problems. It can be recommended that monitoring and evaluation of lead levels in chicken meat and eggs at regular intervals and maintaining data base is very important. Put plans by specified organizations for preventing exposure through controlling or eliminating lead sources. Careful washing of foodstuffs, careful consumption of food from industrial areas, control of discharge of heavy metals and other toxic chemicals to the environment.

ACKNOWLEDGEMENT

The team work of the project wishes to express his deepest appreciation to Science and Technology Development Fund team for funding and the continuous guidance and supporting of this work.

REFERENCE

[1] Abdulkhaliq, A., Swaileh, K. M., Hussein , R. M. and Matani, M. (2012). Levels of metals (Cd, Pb, Cu and Fe) in cow's milk, dairy products and hen's eggs from the West Bank, Palestine. International Food Research Journal 19 (3): 1089-1094.

[2] Abed El-Gowde, E. (1995). The role of Native & improved Native breeds in the Egyptian poultry industries - Fayoum – Jan. 1995, World Poultry Science Association Egypt Branch.

[3] Abou Donia, M. A.; Abou-Arab, A. A. K.; Nevin E.Sharaf, Enab, A. K. and Sherif R. Mohamed (2014). Use of Hair as an Indicator of Environmental Lead Pollution: Changes after Twenty Years of Phasing Out Leaded Gasoline. World Academy of Science, Engineering and Technology International Journal of Medical, Health, Pharmaceutical and Biomedical Engineering, 8 (9): 569-573.

[4] Abou-Arab, A.A.K.; Abou Donia, M.A. ; Nevin E. Sharaf and Sherif R. Mohamed (2014). Lead Levels in Human Blood as Biological Test in Different Egyptian Environments. World Journal of Medical Sciences 10 (4): 392-399.

[5] Abou-Arab, A.A.K.; Abou-Donia, M.A. and Enb, A. (2008). Chemical composition, metals content and pesticide residues in raw, pasteurized and UHT milk and their dietary intake. J. Egypt. Soc. Toxicol. , 39: 111-121.

[6] Abou-Arab, A.A.K. and Abou Donia, M.A. (2002). Lead content in Egyptian foods and the role of washing and peeling on its levels. J. Egypt. Soc. Toxicol.,26: 13-21.

[7] Abou-Arab, A.A.K. and M.A. M. Abou-Donia (2001). Heavy metals in canned foods as affected with storage. J. Agric. Sci. Mansoura Univ., 26 (6): 3787-3799.

[8] Al Othman, Z. A. (2010). Lead Contamination in Selected Foods from Riyadh City Market and Estimation of the Daily Intake. Molecules, 15, 7482-7497

[9] Anonymous (1998). Food and nutrition guidelines for healthy adolescence, Ministry of Health New Zealand. Page: 18. http://www.moh.govt.nz/moh.nsf/0/0697F789B648D3304C25666F0039933A.

[10] AOAC (2000). Association of Official Analytical Chemists, Official Methods of Analysis. Metals and other elements at trace levels in foods. Published by AOAC International Suite 400 2200 Wilson Boulevard Arlington, Virginia 22201-3301 USA.

[11] Bell, D.D. (2002). Commercial Chicken Production Manual, 5th Edition. Pages 1121-1128. Cited by FAO ANIMAL PRODUCTION AND HEALTH DIVISION. Poultry sector country review November 2006.

[12] Chowdhury, M. Z. A. , SiddIque, Z. A. , Hossain, S.M. A. , Kazi, A. I., Ahsan, M. Ahmed, A . S. and Zaan, M. M. (2011). Determination of essential and toxic metals in meat, meat products and eggs by spectrophotometric method. Journal of Bangladesh Chemical Society, 24(2) :165-172.

[13] Correia, P.R.M., Oliveira, E. and Oliveira, P.V. (2000). Simultaneous determination of Cd and Pb in foodstuffs by electro thermal atomic absorption spectrometry. Analytica Chimica Acta, 405: 205-211.

[14] Dabcka, R.W. and McKenzic, A.D. (1992). Total diet study of lead and cadmium in food composites: Preliminary investigations. J. of Association of Official Analytical Chemistry International, 75: 386-394.

[15] EPA (1986). Air quality criteria for lead. EPA publication 600/8- 83/028 df. Environmental Protection Agency, Research Triangle Park, NC USA.

[16] Fakayode, S. O. and Olu-Owolabi, I. B. (2003). Trace metal content and estimated daily human intake from chicken eggs in Ibadan, Nigeria. Archives Environmental Health. 58 (4): 245-251.

[17] FAOSTAT (2009). FAO Statistics Division. Agribusiness handbook Poultry meat & eggs. FAO , FIAT, PANIS.

[18] Hasnath, R. (2002). Effect of Feeding Systems on the Egg Production of Fayoumi Hens of Model Breeding Units under PLDP Program in Bangladesh,M.Sc.Thesis,http://www.kvl.dk/upload/poultry/master_theses/rashed.pdf
[19] Khan, K. and Naeem, M. (2006). Simultaneous determination of accumulated hazardous metals in hen's eggs by atomic absorption spectroscopy. Journal of Applied Sciences, 6(1): 198-201.
[20] Leblanc, J. C., Malmauret, L., Gue´rin, T., Bordet, F., Boursier, B. and Verger, P. (2000). Estimation of the dietary intake of pesticide residues, lead, cadmium, arsenic and radionuclide's in France. Food Addit. Contam., 17: 925-932.
[21] Moriber, G. (1979). Environmental Science. Allyn and Bacon, Boston, M.A.
[22] Nicolas, C. O. , Leo, C. O. and Uche, I. O. (2012). Estimation of Dietary intake of Cadmium, Lead, Manganese, Zinc and Nickel due to consumption of chicken meat by inhabitants of Port-Harcourt Metropolis, Nigeria. Archives of Applied Science Research, 2012, 4 (1):675-684.
[23] Pitot, C.H. and Dragan, P.Y. (1996). Chemical carcinogenesis. In: Casarett and Doull's Toxicology, 5th Edn. International Edition, Mc Graw Hill, New York, pp: 201-260.
[24] RDA (1989). Recommended Dietary Allowance 10th edition, National Academy of Sciences.
[25] Rizk, F.S.H. and Khoder, M.I.M. (2001). Decreased lead concentration in Cairo atmosphere due to use of unleaded gasoline. CEJOEM, 7 (1): 53-59
[26] Shakour, A.A., El-Taieb, N.M. and Hassan, S.K. (2006). Seasonal variation of some heavy metals in total suspended particulate mater in Great Cairo atmosphere. The 2nd International Conference of Environmental Science and Technology, Egypt.
[27] Snedecor, G.W. and Cochran, W.G. (1980). "Statistical Methods", 7th Ed. Oxford and IBIT public. Co. New York.
[28] Tahvonen, R. and Kumpulainen, J. (1994). Lead and cadmium contents in pork, beef and chicken and in pig and cow liver in Finland during 1991. Food Additives and contaminants, 11 (4): 415-426.
[29] Turk, A., Turk, J. and wittes, J. (1973). Ecología. Contamination Medio Ambiente. Editorial Interamericana, Mexico, PP. 96-101. Cited by Durando and Aragon (1982).
[30] Tuzen, M. and Soylak, M. (2007). Determination of trace metals in canned fish marketed in Turkey. Fd. Chem., 101: 1378–1382.
[31] Vos, G.; Lammers, I.I. and Kon, C.A. (1990). Cadmium and lead in muscle tissues and organs of broilers, turkeys and spent hens and in mechanically deboned poultry meat. Food Additives and Contaminants, 7: 83-91.
[32] Ward, N.I. (1995). Environmental Analytical Chemistry In Trace Elements (eds: Fifield FW and Haines PJ), Blackie Academic and Professional, London, p 320-328.
[33] WHO (2007). Health risks of heavy metals from long-range Trans boundary air pollution. Joint WHO/Convention Task Force on Health Aspects of Air Pollution.
[34] WHO (1987). Air Quality Guideline for Europe, WHO Regional Publication, European Series No. 23, Copenhagen.
[35] WHO (1998). Copper, Environmental Health Criteria No. 200, WHO, Geneva.
[36] WHO (1989). Lead Environmental Aspects. Environmental Health Criteria 85, Geneva.
[37] WHO (1995). Inorganic Lead, Environmental Health Criteria No. 165, WHO, Geneva.
[38] WHO (1996). Trace Elements in Human Nutrition and Health, WHO, Geneva.
[39] Yilmaz, F. (2009). The Comparison of Heavy Metal Concentrations (Cd, Cu, Mn, Pb, and Zn) in Tissues of Three Economically Important Fish (Anguilla anguilla, Mugil cephalus and Oreochromis niloticus) Inhabiting Köycegiz Lake-Mugla (Turkey). Turkish Journal of Science & Technology, 4(1): p.7-15.
[40] Yilmaz, F., Ozdemir, N., Demirak, A. and Tuna, A.L. (2007). Heavy metal levels in two fish species Leuciscus cephalus and Lepomis gibbosus. Fd. Chem., 100: 830-835.