HEAVY METALS DETERMINATION IN IMPORTED FROZEN MEAT

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ABSTRACT

*45 random samples of imported frozen meat were collected from Al-Gharbiah markets, Egypt. The collected samples were represented by Brazilian, Columbian and Indian meat (15 of each). The collected samples were examined for cadmium, lead and mercury concentrations on the basis of wet weight (mg/kg) by Atomic Absorption Spectrophotometer (AAS). The obtained results revealed that the mean concentrations of cadmium in the examined samples of imported frozen Brazilian, Columbian and Indian meats were 0.06 ± 0.01 mg/kg; 0.14 ± 0.01 mg/kg and 0.19 ± 0.01 mg/kg, respectively, while the mean concentrations of lead in the examined samples of imported frozen Brazilian, Columbian and Indian meats were 0.35 ± 0.02, mg/kg; 0.41 ± 0.02 mg/kg and 0.52 ± 0.03 mg/kg, respectively , concerning to mercury it could not be detected in the examined samples of imported frozen Brazilian meat, while the mean concentrations of mercury in the examined samples of imported frozen Columbian and Indian meats were 0.20 ± 0.01 mg/kg and 0.37 ± 0.02 mg/kg, respectively. Comparing the results to the maximum permissible limits stated by the Egyptian Organization of Standardization **"EOS" (2005),** found that the examined imported frozen Indian meat contained the highest residual concentration of heavy metals (cadmium, lead and mercury) followed by Columbian and Brazilian.*

INTRODUCTION

In order to improve the animal protein content in the Egyptian food, under the current economic situations, especially when the fresh red meat have extremely rising prices and under the limitation of the individual's income, the imported frozen meat could be replaced and must be sufficiently available with the required food content ***(Shafiq et al., 2009)***.

Imports of frozen beef in Egypt were expected to increase slightly as a result of short supply of locally produced meat coupled with a growing population ***(Maldonado and Sherif, 2010).***

The only way to complete all the amino acids needed for our proper tissue formation, growth and repair is through the intake of animal protein. One of the most common animal protein sources in the world is the cattle meat. The cattle habitat was continually been polluted with cadmium, lead and other metals as a result of indiscriminate dumping of waste materials on the land, plants and water in which cattle was freely graze and drink ***(Kamala and Kumar, 1998)***.

Cadmium, Lead and Mercury are among the main toxic heavy metals, which accumulate in food chains and have a cumulative effect ***(Ferguson, 1990).***

From the public health of view this work was planned to detect the concentrations of heavy metal contaminants of (Cadmium, Lead and Mercury) in imported frozen meat from different countries.

MATERIALS AND METHODS

1- Collection of samples:

A total of 45 random samples of imported frozen meat were collected from Al-Gharbiah markets, Egypt. the collected samples were represented by Brazilian, Columbian and Indian meat (15 of each). The collected samples were examined for cadmium, lead and mercury concentrations on the basis of wet weight (mg/kg).

2- Determination of heavy metal residue:

Instrumental procedures for various analyses of heavy metals were based on those suggested in the operator manual of the Atomic Absorption Spectrophotometer "AAS" (UNICAM969AA Spectro-photometer).

2-1-Digestion technique:

The samples were prepared and digested according to the technique described by ***Shibamoto and Bjeldanes (1993).***

2-2- Preparation of blank and standard solutions:

Preparation of blanks and standard solution in the same manner was applied for wet digestion.

2-3- Analysis:

The digest, blanks and standard solutions were aspirated by Atomic Absorption Spectrophotometer (AAS) and analyzed for cadmium, lead and mercury under the following conditions:

Conditions	Cadmium	Lead	Mercury
Lamp wave length (nm)	228.8	217.0	253.7
Lamp current (m/amp)	10	15	10
Fuel flow rate	1.2	1.4	1.2
Measurement time (seconds)	4.0	4.0	4.0
Detection limit (mg/kg)	0.01	0.01	0.01

N.B: Estimation of heavy metals in each examined sample was expressed by (mg/kg) of wet weight samples.

2-4- Quantitative determination of heavy metal residues:

Cadmium, lead and mercury absorbency were recorded directly from the digital scale of AAS and their concentrations were calculated, according to the following equation: C=R x (D/W)

RESULTS

Table (1): Statistical analytical results of cadmium concentrations in the examined samples of imported frozen meat (n=15).

Types of imported meat	NO. of positive samples	Percentage of positive samples	Concentrations (mg/kg)		
			Min	Max	Mean ± S.E
Brazilian	3	20.00	0.03	0.08	0.06 ± 0.01
Columbian	3	20.00	0.05	0.31	0.14 ± 0.01
Indian	5	33.33	0.06	0.51	0.19 ± 0.01

Table (2): Acceptability of the examined imported frozen meat samples based on their concentrations of cadmium.

Type of samples	NO. of samples	NO. of samples above MRL	% of samples above MRL (Unaccepted)	MRL (mg/kg)*
Brazilian	15	0	0	0.1
Columbian	15	1	6.67	0.1
Indian	15	2	13.33	0.1

* Egyptian Organization of Standardization ***"EOS" (2005)***

Table (3): Statistical analytical results of Lead concentrations in the examined samples of imported frozen meat (n=15).

Types of imported meat	NO. of positive samples	Percentage of positive samples	Concentrations (mg/kg)		
			Min	Max	Mean ± S.E
Brazilian	3	20.00	0.17	0.59	0.35 ± 0.02
Columbian	4	26.67	0.22	0.69	0.41± 0.02
Indian	6	40.00	0.29	0.93	0.52 ± 0.03

Table (4): Acceptability of the examined imported frozen meat samples based on their concentrations of Lead.

Type of samples	NO. of samples	NO. of samples above MRL	% of samples above MRL (Unaccepted)	MRL (mg/kg)*
Brazilian	15	1	6.67	0.5
Columbian	15	1	6.67	0.5
Indian	15	3	20.00	0.5

* Egyptian Organization of Standardization ***"EOS" (2005)***

Table (5): Statistical analytical results of mercury concentrations in the examined samples of imported frozen meat (n=15).

Types of imported meat	NO. of positive samples	Percentage of positive samples	Concentrations (mg/kg)		
			Min	Max	Mean ± S.E
Brazilian	0	0	UD	UD	UD
Columbian	2	13.33	0.09	0.31	0.20 ± 0.01
Indian	2	13.33	0.14	0.60	0.37 ± 0.02

UD=Undetectable

DISCUTION

It is evident from the results recorded in table (1) that the examined samples of imported frozen Brazilian, Columbian and Indian meat were positive for cadmium with concentration from 0.03 to 0.08 mg/kg with an average mean 0.06 ± 0.01 mg/kg; 0.05 to 0.31 mg/kg with an average mean 0.14 ± 0.01 mg/kg and 0.06 to 0.51 mg/kg with an average mean 0.19 ± 0.01 mg/kg, respectively. The above mentioned concentrations nearly similar to those obtained by ***Alonso et al. (2000); Korenekova et al. (2002)*** and ***Miranda et al. (2005),***while higher concentrations were recorded by ***Irfana et al. (2004)*** and ***Nwude et al. (2011)***,while lower concentration was reported by ***Rahimi and Rokni (2008).***

According to the permissible limits of cadmium stipulated by ***(EOS, 2005)*** the results in table (2) showed that 6.67% and 13.33% of the examined imported frozen Columbian and Indian meat were unacceptable, respectively.

Concerning to the results recorded in table (3) 20%, 26.67% and 40% of the examined samples of imported frozen Brazilian, Columbian and Indian meat were positive for lead with concentrations from 0.17 to 0.59 mg/kg with an average mean 0.35 ± 0.02, mg/kg; 0.22 to 0.69 mg/kg with an average mean 0.41 ± 0.02 mg/kg and 0.29 to 0.93 mg/kg with an average mean 0.52 ± 0.03 mg/kg for imported frozen Brazilian, Columbian and Indian meat, respectively. The above mentioned concentrations nearly similar to those obtained by ***Ilie et al. (2007)***, while higher concentrations were recorded by ***Korenekova et al. (2002)*** and ***Irfana et al. (2004)***, while lower concentration was reported by ***Falandysz and Lorenc-Biala (1991).***

Egyptian Organization of Standardization ***"EOS" (2005)*** stipulated a maximum permissible limit of lead to be 0.5 mg/kg in meat. So that 6.67%, 6.67% and 20% of the examined imported frozen Brazilian, Columbian and Indian meat was unacceptable, respectively, (Table 4).

The results recorded in table (5) showed that mercury could not be detected in the examined samples of imported frozen Brazilian meat, while 13.33% of each of examined Columbian and Indian frozen meat sample were positive for mercury with concentrations ranged from 0.09 to 0.31 mg/kg with an average mean 0.20 $\pm$ 0.01 mg/kg and 0.14 to 0.60 mg/kg with an average mean 0.37 $\pm$ 0.02 mg/kg, respectively. The above mentioned concentrations nearly similar to those obtained by ***Vos et al. (1992)***and ***Kottferova and Korenekova(1995)***,while higher concentration was recorded by ***Irfana et al. (2004)*** and lower concentrations were reported by ***Jorhem et al. (1991)*** and ***Zarski et al. (1994).***

Egyptian Organization of Standardization ***"EOS" (2005)*** not stipulated a maximum permissible limit of mercury in meat.

The obtained results in the present study indicated that the examined imported frozen Indian meat contained the highest residual levels of heavy metals (cadmium, lead and mercury) followed by Columbian and Brazilian meat.

All heavy metals are toxic at certain levels of intake, however, in contrast to elements such as lead, mercury and cadmium as far as we know play no useful role and pose a risk for both animal and human health, due to their presence in the food chain and tend to accumulate in animal tissues ***(Miranda et al., 2003).***

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تقدير العناصر الثقيلة فى اللحوم المجمدة المستورده

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أجريت هذه الدراسة التحليلية لمعرفة مدى تواجد بعض الملوثات البيئية من المعادن الثقيلة مثل (الكادميوم والرصاص والزئبق) فى اللحوم المستوردة. وقد تم اجراء الدراسة على عدد 45 عينة عشوائية من اللحوم المجمدة المستوردة (البرازيلية و الكولومبية والهندية) 15 عينة من كل نوع والتي تم جمعها من مختلف الأسواق المحلية.

وقد أشارت نتائج هذه الدراسة الي أن متوسط تركيز الكادميوم في اللحوم المستوردة البرازيلية والكولومبية والهندية هى 0.06 ± 0.01 ؛ 0.14 ± 0.01 و 0.19 ± 0.01 مجم / كجم على التوالي .

وطبقا للمواصفات القياسية المصرية فان اللحوم البرازيلية المستوردة مقبولة و 6.67٪ و 13.33٪ من اللحوم المستوردة الكولومبية والهندية، على التوالي، غير صالحة وتتجاوز الحد الاقصى المسموح بة لعنصر الكادميوم .

وبالنسبة لمتوسط تركيز الرصاص في اللحوم المستوردة البرازيلية والكولومبية والهندية هو 0.35 ± 0.02 ؛ 0.41 ± 0.02 و 0.52 ± 0.03 مجم / كجم على التوالي.

و وفقا للحدود المسموح بها فان 6.67٪، 67.6٪ و 20٪ من اللحوم المستوردة البرازيلية والكولومبية والهندية على التوالي غير مقبولة وتتجاوز الحد الاقصى المسموح بة لعنصر الرصاص.

لا توجد بقايا الزئبق في عينات اللحوم المستوردة من البرازيل ، في حين أن متوسط التركيزات من الزئبق في عينات اللحوم الكولومبية والهندية المستوردة هى0.20 ± 0.01 و 0.37 ± 0.02 مجم / كجم ,على التوالي.

وطبقا للمواصفات القياسية المصرية فان اللحوم البرازيلية المستوردة مقبولة بينما 13.33٪ من كل من اللحوم المجمدة الكولومبية والهندية على التوالي، غير مقبولة وتتجاوز الحد الأقصى المسموح بة لعنصر الزئبق.

كما أشارت النتائج التي تم الحصول عليها من هذه الدراسة أن اللحوم الهندية المجمدة تحتوي على أعلى المستويات من متبقيات المعادن الثقيلة (الكادميوم والرصاص والزئبق) ، يليها اللحوم الكولومبية ثم البرازيلية.