 ISSN 1110-7219

SOME HEAVY METAL RESIDUES IN FAST FOODS (READY TO EAT) COLLECTED FROM ALEXANDRIA GOVERNORATE

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ABSTRACT

A total of 150 samples of restaurant and street vended fast foods including shawerma, sausage,hamburger,kofta and liver sandwiches (15 samples of each) were collected from different restaurants and street vendors in Alexandria governorate to determine the Levels of heavy metals (cadmium, lead, mercury ,copper, nickel and zinc.), . The results revealed that levels of heavy metal residues in all the examined samples were within the Egyptian standard permissible limits with the exception of levels of cadmium and lead ,which were above the limits in street vended food samples .At the same time, levels of heavy metals in street vended food samples were significantly higher than levels of heavy metals in restaurant food samples. Concerning , cadmium (Cd) and lead (Pb), the highest levels (0.256±0.191, 1.489±0.767) were in liver sandwiches., respectively. In case of copper (Cu) and nickel (Ni), the highest levels (0.379±0.134 , 0.197±0.098) were in kofta sandwiches., respectively . Regarding, mercury(Hg) and zinc(Zn), the highest mean concentrations (0.408±0.145, 2.862±0.200.) were in sausage sandwiches., respectively.

INTRODUCTION

Increasing industrialisation has been accompanied throughout the world by the extraction and distribution of mineral substances from their natural deposits. Following concentration, many of these have undergone chemical changes through technical processes and finally pass, finely dispersed and in solutions, by way of effluent, sewage, dumps and dust, into the water, the earth and the air and thus into the food chain.These include heavy metals **(Lauren, , 2009)**.

Heavy metals are metals which have a high atomic mass, including, for example, cadmium, lead, mercury and arsenic, heavy metals are usually toxic in low amounts and are therefore a potential health hazard. Metals can occur in a variety of foodstuffs of plant and animal origin. Mostly, they arise indirectly in foodstuffs from the environment - e.g. they are in soil that the crop is grown in, or on the grass that a cow is eating or in the water in which a fish is living. As such, once they become incorporated into the food they cannot be removed. Control of raw materials is, therefore, the only mechanism for ensuring that levels do not become unsafe. There is a risk to crops and animals themselves from metals in the environment (e.g. they can kill plants and reduce yields) and to humans from eating crop and livestock products. Metals which can be particularly harmful to animals and man include lead, cadmium, arsenic, mercury, copper, selenium and molybdenum. These elements can accumulate in primary products that are otherwise growing satisfactorily, but still affect animals and man **(Irfana., et al., 2004)**.

Fast foods are ready to-eat foods or beverages, which includes many types of foods ranging from cereal and fruits to cooked meats and drinks. It is usually prepared and/ or sold in streets and other similar public places, such as: pavements, roadways, back alleys of markets, school premises ,bus and railway stations, beaches, parks and other public spaces **(Mensah, et al., 2002)**.

A possible source of heavy metal contamination in fast foods is locally manufactured metal pots, in which street foods are cooked and stored. The small-scale enterprises that manufacture these ports are thought to add lead to the aluminium, to reduce the melting temperature to that within the capacity of their furnaces. Other sources of lead may be airborne (leaded petrol), water stored in metal tanks, ingredients and soil. Low, but non-hazardous, levels of the heavy metal cadmium was detected in many street vended food samples. Therefore., the purpose of this study is to determine the levels of some heavy metal residues in fast foods (shawerma, sausage, hamburger, kofta and liver sandwiches) collected from different restaurants and street vendors in Alexandria governorate.

MATERIALS AND METHODS

A total of 150 samples of restaurant and street vended fast foods (shawerma, sausage, hamburger, kofta and liver sandwiches) (15 samples of each) were collected randomly from different restaurants and street vendors in Alexandria governorate. Samples were transported in an insulated ice box to the laboratory and analyzed for heavy metals. The principle of the minerals determination involved the production of acidic solution of the inorganic elements, after removing interfering materials by chelation solvent using ammonium pyrrolidine di-thio carbamate (APDC) and methyl isobutyl ketone (MIBK) After that minerals concentrations were determined by using flame atomic absorption spectrophotometer model perkin Elemer 2380 at wave length's specific to each element **(Richard., 1986)**.

Cadmium., lead, copper., nickel, and zinc were determined by Hydrochloric-nitric (HCl-HNO_3) acid leaching method using flame atomic absorption spectrophotometer model Perkin Elemer 2380 **(Richard., 1986).** The principle of mercury(Hg) determination method depends on the conversion of all the mercury present in the sample into the inorganic form by wet oxidation and it's reduction to the metallic state. Then, the release of mercury from the solution as vapour using a stream of air followed by it's determination by flameless atomic absorption spectrophotometer **(APHA/ AWWA 1992)** .

RESULTS AND DISCUSSION

Improvements in the food production and processing technology had increased the chances of contamination of food with various environmental pollutants, especially heavy metals. Ingestion of these contaminants by animals causes deposition of residues in meat. Over the past few decades, both developed and developing countries have experienced equally life and food style changes that have led to an increased demand for processed foods. Some heavy metals get deposited in food as residues during processing When the residue levels go beyond the prescribed standards, they cause deleterious effects on human health, especially when consumed continuously. **(WHO, 1987)**.

Table (1) showed the statistical analytical results of heavy metals in restaurant food samples(ready to eat)collected from Alexandria governorate. It was found that the highest levels of cadmium was found in liver sandwiches with a mean value of 0.056±0.035 while the lowest was in hamburger with a mean value of 0.02±0.01.respectively. Concerning lead, Kofta showed the highest mean concentration (0.631±0.078) while shawerma had the lowest (0.316±0.059), respectively. In case of mercury, the highest mean concentration (0.358±0.086) was in liver sandwiches, while the lowest (0.216±0.061) was in hamburger. Regarding, copper, nickel and zinc, the highest mean concentrations (0.220± 0.081., 0.147±0.048, 1.834±0.716) were in sausage, liver and sausage, respectively with no significant difference between means of copper in liver, shawerma and hamburger . At the same time, there was a highly significant difference between means of Zn in shawerma and the same is true for sausage, hamburger., there were also a highly significant difference between means of cd,pb and Zn in kofta sandwiches (Table ,1).

It was found that there was a significant difference between means of lead and Nickel in shawerma, between pb, Hg, Cu and Ni in sausage, between pb, Hg, and Ni in hamburger, between Hg,Ni in kofta and between pb, Ni in liver sandwiches, respectively (Table, 1).

It was reported that the mean values of cadmium, copper, lead, zinc, and nickel concentrations in sausage and meat are quite variable such as, Zn (20-159 g/100gm), Ni (8.2-24 g/100gm), Cd (0.77-1.04 g/100gm), Cu (7.18-10.01 g/100gm), and Pb (11.5-13.5 g/100gm). The order of the levels of the trace elements in the studied samples of sausage and meat was Zn > Ni > Pb > Cu > Cd. **(Dilek and Kadjriye., 2006,; Moeller,et al.,, 2003 and Abou-Arab, 2001)**.

Coni, et al., (1996) found that liver of cows had higher levels of cadmium, copper, lead and mercury than the liver of sheep and goat.

Abou-Arab, 2001 found that the lead content of sausage was higher than that of the meat used for its production, presumably due to the spices used in sausage production **(Abou-Arab,2001)**.

Our results indicated that levels of cadmium and lead in all restaurant food samples(shawerma, sausage,hamburger, kofta and liver sandwiches) were within theEgyptian standard permissible limits (0.1p.p.m, 1p.p.m., respectively). (table 1) **(EOS.,1993)**. These results were coincide with Monica., **Roman., 2005**, who found that cadmium and lead leves of raw dry meat products(beef,sausage) obtained as industrial meat products at 3 factories in the Brasov area in Romania were within the standard permissible limits **(Monica., Roman., 2005)**.

It was illusterated that the mercury levels in restaurant food samples (shawerma, sausage, hamburger, kofta and liver sandwiches) collected from Alexandria governorate were within the Egyptian standard permissible limits (0.5 p.p.m) Table (1). **(EOS.,1993)**. These results disagreed with **Zarski, et al., (1997)** who reported that the mercury levels in liver of cattle exceeded the accepted hygienic standards **(Zarski, et al., 1997)** and agreed with **Swsan., M. A., 2008**, who found that levels of mercury in meat and liver collected from slaughtered animals in Alexandria were within the Egyptian standard permissible limits **(Swsan., 2008)**.

The main sources of mercury contamination may be industrial wastes, pesticides and fungicides. The mercury escapes into the air and soil and get accumulated in fodder plants and hence, in animal tissues. **(Zarski, et al,. 1997)**.

Our results indicated that levels of copper, and Zinc in restaurant food samples (shawerma, sausage, hamburger, kofta and liver sandwiches) were within the Egyptian standard permissible limits (3.5p.p.m., 40p.p.m.) **(EOS., 1993)**. table(1). These results was agreed with **Swsan., M. A., 2008**, who found that levels of copper, and Zinc in meat and liver collected from slaughtered animals in Alexandria were within the Egyptian standard permissible limits **(Swsan., 2008)**.

The statistical analytical results of heavy metals in street vended food samples(ready to eat) collected from Alexandria governorate were recorded in Table (2). Concerning cadmium and lead, the highest levels (0.256 ± 0.191, 1.489 ± 0.767)were in liver with a highly significant difference between means of cadmium and lead in liver. Our results showed that cadmium and lead concentrations in all the samples of street vended foods were higher than the Egyptian standard permissible limits (0.1 p.p.m, 1p.p.m., respectively) **(EOS., 1993)**. These results was in agreement with **Aranha, 1994**, who found that the liver of beef showed the highest concentration of lead (1.25 ppm)which exceeded the permissible limit of 1 ppm (ANZFA) **(Aranha, 1994)** and disagreed with **Swsan., M. A., 2008**, who found that the highest concentration of cadmium., lead (0.223 p.p.m.., 0.024 p.p.m., respectively)were in liver., collected from slaughtered animals in Alexandria and the levels were within the Egyptian standard permissible limits **(Swsan., 2008)**.

Our results showed that there was a significant difference between means of mercury and Nickel in sausage., between cadmium, mercury in hamburger, and between cd,pb in kofta. At the same time, there was no significant difference between means of mercury, copper and Nickel in shawerma and between means of mercury and copper in liver Table (2).

There was a highly significant difference between means of cd, pb and Zn in shawerma, and the same is true for sausage, liver and kofta while, there was a highly significant difference between means of, pb. Ni and Zn in hamburger and there was also a highly significant difference between means of Ni and Zn in kofta .

It was found that the cadmium levels in

the livers of cattle of Poland were above the action level. (**Roga, et al., 1996 and Stoyke, et al,. 1995**).

Contamination of meat products with cadmium might occur in three ways, one from animals grazing on lands spread with sewage sludge or phosphate fertilizers and another from animals grazing on lands contaminated with industrial cadmium effluent . The cadmium-contaminated mineral components of commercial feeds and phosphate fertilizers were found to have strong correlation to concentrations in animal tissues. Cadmium from the soil could reach man through vegetables, milk and meat (**Stenstrom and Lonsjo, 1974**).

It was reported that the lead mean concentration of lean meat of beef was higher than the permissible limit of 1ppm (ANZFA). (**Aranha, 1994**).

It was found that the mean concentrations of lead and cadmium in Venezuelan meat samples were 0.28 mg kg_1 dry weight and 0.18 mg kg_1 dry weight (**Taha'n, et al., 1995**).

Lead is known to induce reduced cognitive development and intellectual performance in children and increased blood pressure and cardiovascular disease in adults . It is also associated with cancer and infertility. Lead could cause adverse effects on the renal and nervous systems and cross the placental barrier and having potential toxic effects on the fetus (**Commission of the European Communities, 2001, Tuormaa, 1995; WHO, 2003 and Pueschel, et al., 1996**).

Oskarsson, et al., (1992) reported a high lead concentration (500 ug kg-1) in beef after accidental exposure to lead Oskarsson, et al.., (1992).

Vreman, et al., (1988) found higher concentrations of lead in the muscle of dairy cows raised on pasture than in the muscle of dairy cows kept indoors **Vreman. et al., (1988)**.

Humphreys, (1991) reviewed the effects of lead in animals and reported that due to its slow rate of elimination, harmful levels of lead could accumulate in tissues after prolonged exposure to even low quantities of lead. The most hazardous heavy metal monitored on the swine farms in the district of Hodonin, Czech Republic in 1994-1999 was lead, the major source of which being paint coats containing more than 0.6 g lead kg^{-1}, mineral components of commercial feeds, scrap lead batteries put away in barns and lead-coated guide bars of electric lines (**Ulrich, et al.., 2001**).

It was indicated that the highest mean concentration of mercury (o.408$\pm$0.145) was in liver sandwiches from street vendors. The results revealed that levels of mercury residues in all the street vended foods were within Egyptian standard permissible limits table(2). These results agreed with **Samek. et al,. (1997)** who found that the highest mean concentration of mercury (less than 0.01 p,p,m,) was in beef and this level was within the standard permissible limits **Samek. et al,. (1997)** .

The main sources of mercury contamination may be industrial wastes, pesticides and fungicides. The mercury escapes into the air and soil and get accumulated in fodder plants and hence, in animal tissues. **(Irfana ., et al., 2004)**.

Table (2) showed that the highest levels of copper and nickel (0.379±0.134, 0.197±0.098) were in kofta., respectively. In case of zinc, the highest mean concentration (2.862±0.200) was in sausage. Our results indicated that levels of mercury, copper, nickel and Zinc in all the samples of street vended foods were within the Egyptian standard permissible limits table (2).

The main source of contamination of foods with copper was copperware used to store or cook foods. Copper, although not essentially toxic, could cause public health hazards in high concentrations In humans, 10-30 mg of orally ingested copper from foods stored in copper vessels might cause intestinal discomfort, dizziness and headaches, while excess accumulation of copper in liver may result in hepatitis or cirrhosis and in a hemolytic crisis similar to that seen in acute copper poisoning **(Rajmane, et al., 1986 and Brito, et al., 1990)**.

Copper is essential component of various enzymes and it plays a key role in bone formation, skeletal mineralization and in maintaining the integrity of the connective tissues. It is essential element but its concentration in the livers of mutton suggests that it may not be used frequently and get accumulated in large concentrations. **(Irfana., et al., 2004)**.

It was found that levels of zinc (microgm/gm) in hamburger, sausage,hamburger regular and hamburger deluxe sandwiches collected from franchised chains in Utah in Maxico. were 26±5, 23± 6, 31±7 and 36±10., respectively **(KirK., et al., 1991)**.

Abou-Arab (2001) found Zn and Pb in different types of meat products in concentration ranges of 7.3-1.1 mg kg^{-1} and 0.010–0. 061 mg kg^{-1}, respectively, **Abou-Arab (2001)**.

Jozef, et al., (1997) reported that the highest concentration of zinc was in the liver and the lowest was in meat tissue of cattle. The low concentration of zinc may be attributed to zinc deficient soils, consequently the fodder/cereals available to cattle are deficient of zinc. Perhaps, this is one of the reasons for low tissue content of zinc. **(Jozef, et al., 1997)**.

The levels of nickel, were determined in samples of meat, liver from cattle from Swedish slaughter houses. The mean levels of nickel were found to be in the range <0.010-0.015 mg/kg, regardless of the type of tissue. **(Lars Jorhem1, et al., 12006)**.

Simakova, et al., (1993) reported a zinc level upto 83.2 mg kg^{-1} in beef. **(Simakova, et al., 1993)** .

Food and diets high in protein were found to have high zinc **(Osis, et al.., 1972)**. The major source of readily bioavailable zinc in theUS diet is beef **(Welshand and Marston, 1982)**.

Highest copper concentration was found in the liver of mutton (318.82 ppm) and lowest

(5.01ppm) in the lean meat of mutton. The copper concentration in the livers of mutton was higher than the permissible limit of 200 ppm (ANZFA) **(Irfana ., et al., 2004)**.

Mukhacheva and Bezel (1995) found high levels of copper and zinc in the liver of beef. **Mukhacheva and Bezel, (1995)**.

It was illustrated that frozen commercial pork products(ham and sausage) obtained from retail outlets of Chinna city , had copper levels of 0.37 mg kg^{-1} and 0.536 mg kg^{-1}., respectively .while., the cadmium levels were 0.230 mg kg^{-1}, 0.238 mg kg^{-1}., respectively.In case of lead., levels were 1.966 mg kg^{-1} and 1.352 mg kg^{-1}., for ham and sausage., respectively. At the same time, zinc levels were 34.813 mg kg^{-1} and 35.718 mg kg^{-1}., respectively. **(Sanofhi., et al., 2008, Larkin, et al., 1954 , and Brito, et al., 1990)**.

Rajmane, et al., (1986) reported high concentration of copper in salami samples (13.8 ppm) However none of the samples in this study had copper content exceeding the MPL (20 ppm) prescribed by **MFPO (1973)** in meat products. **Rajmane, et al., (1986)**.

It was found that the street vended food samples showed significantly higher levels of heavy metals than restaurant food samples (Table 3) . The high levels may be due to the conditions under which street vended foods are sold, there is concern that food may be contaminated by heavy metals. These contaminants may come from the utensils, raw materials, or transport methods used and may also occur due to the lack of appropriate storage facilities.

Our results indicated that levels of heavy metals in street vended food samples were within the Egyptian standard permissible limits with the exception of cadmium and lead which exceeded the limits (Table 3). This was attributed to possible leaching from the utensils. Further tests showed that lead from the pots obtained from informal manufacturers could leach into the food. These pots are manufactured using scrap metal that could come from diverse sources such as derelict cars, car batteries and industrial machinery, which are obviously not suitable for use with foods **(Mensah., etal., 2002)**.

A study carried out in Accra revealed that street food vendors source their pots and other utensils from both formal and informal manufacturers / retailers. Interviews with vendors in Harare showed that some of their utensils come from informal sources. This was attributed to the fact that when police raid these vendors, they usually confiscate their wares, including the pots and utensils. For fear of losing their more expensive pots, the vendors resort to using informally fabricated pots, thereby exposing consumers to the possibility of food contamination by heavy metals **(Mensah, et al., 2002)**.

Primary contamination of meat products with heavy metals may be due to the contamination of meat itself. Secondary contamination may occur due to processing and addition of spices., like pepper which contains higher levels of lead >2.5ppm **(Larkine., et al., 1954)**.

It was found that the highest zinc concentration (66.26 ppm) was in the lean meat of beef. All the values in the study samples were below the permissible limit (150 ppm) set by Australia New Zealand Food Authority (ANZ-FA).

COCLUSIONS AND RECOMMENDATIONS

In conclusion, the present study indicated that levels of heavy metals in restaurant and street vended food samples were within the Egyptian standard permissible limits except levels of cadmium and lead in street vended food samples were exceeded the limits. hence, there is a need for concerted efforts to improve the safety of street vended foods . The food handlers need more information on food safety, which can be disseminated through various media outlets such radios, television, posters and billboards. The street food vendors themselves concede that there is need to re-emphasize the important points of the hygienic handling of food through on-site training and regular visits from the health inspectors.food vendors should be encouraged to operate from designated places and local authorities should provide the necessary infrastructure in order to improve the safety of street vended foods.

Table(1) : Statistical analytical results of heavy metals in restaurant food samples (ready to eat)collected from Alexandria governorate.

	Shawerma			Sausage			Hamburger			Kofta			Liver		
Heavy metals (p.p.m.)	**Min**	**Max**	**Mean ± S.D**	**Min**	**Max**	**Mean ± S.D**	**Min**	**Max**	**Mean ± S.D**	**Min**	**Max**	**Mean ± S.D**	**Min**	**Max**	**Mean ± S.D**
Cadmium(Cd)	0.020	0.080	0.044**± 0.010	0.012	0.058	0.035**± .010	0.010	0.040	0 .020**±.0.01	0.020	0.060	0.040**± 0.016	0.042	0.083	0.056**±0.035
Lead (pb)	0.192	0.412	0.316*± 0.059	0.312	0.488	0.411*±0.161	0.020	0.480	0.444*± 0.146	0.554	0.772	0.631**±0.078	0.234	0.481	0.350*±0.080
Mercury (Hg)	0.169	0.342	0.232± 0.080	0.212	0.364	0.354*±0.124	0.186	0.531	0.216*±0.061	0.192	0.394	0.286*±0.070	0.225	0.458	0.358±0.086
Copper (Cu)	0.171	0.245	0.191±0.053	0.122	0.283	0.220*±0.081	0.080	0.246	0.112±0.021	0.062	0.182	0.080±0.015	0.162	0.245	0.205±0.029
Nickle (Ni)	0.055	0.287	0.094*± 0.048	0.043	0.194	0.111*±0.023	0.017	0.091	0.060*±0.008	0.063	0.119	0.091*±0.019	0.068	0.209	0.147*±0.081
Zinc (Zn)	1.096	2.263	1.162**± 0.042	1.565	2.123	1.834**±0.716	1.092	2.163	1.539**±0.675	1.185	1.497	1.330**±0.106	1.349	1.530	1.424**±0.067

* There was a significant difference between Means at $p \leq 0.05$

** There was a highly significant difference between Means at $p \leq 0.05$

Table (2) : Statistical analytical results of heavy metals in street vended food samples(ready to eat)collected from Alexandria governorate.

	Shawerma			Sausage			Hamburger			Kofta			Liver		
H Heavy metals (p.p.m.)	**Min**	**Max**	**Mean ± S.D**	**Min**	**Max**	**Mean ± S.D**	**Min**	**Max**	**Mean ± S.D**	**Min**	**Max**	**Mean ± S.D**	**Min**	**Max**	**Mean ± S.D**
C CaCadmium(Cd)	0.123	0.193	0.174**± 0.010	0.112	0.183	0.135**± 0.026	0.140	0.222	0.179*± 0.060	0.173	0.261	0.209*± 0.056	0.207	0.291	0.256**±0.191
L Lead (pb)	1.158	1.328	1.226**± 0.059	1.101	1.234	1.1731**±0.161	1.152	1.320	1.238**± 0.140	1.203	1.323	1.2501*±0.243	1.423	1.564	1.489**±0.767
Mercury(Hg)	0.179	0.383	0.296 ± 0.112	0.232	0.451	0.408*±0.145	0.312	0.425	0.365*±0.114	0.230	0.348	0.302±0.180	0.162	0.445	0.379±0.081
Copper(Cu)	0.261	0.392	0.302±0.082	0.198	0.323	0.292±0.049	0.213	0.336	0.282±0.020	0.314	0.498	0.379±0.134	0.216	0.392	0.302±0.083
Nickle(Ni)	0.031	0.286	0.160± 0.010	0.083	0.202	0.189*±0.070	0.083	0.292	0.161**±0.050	0.131	0.268	0.197**±0.098	0.031	0.286	0.160±0.023
Zinc(Zn)	1.167	2.892	2.139**± 0.842	2.123	3.423	2.862**±0.200	2.145	3.468	2.689**±0.214	1.192	2.561	1.948**±0.852	1.167	2.892	2.139**±0.842

* There was a significant difference between Means at $p \leq 0.05$

** There was a highly significant difference between Means at $p \leq 0.05$

Table (3) : Statistical analytical results of heavy metals in restaurant and street vended food samples(ready to eat)collected from Alexandria governorate

Heavy metals (p.p.m.)	Shawerma		Sausage		Hamburger		Kofia		Liver	
	Restaurant	Street vendors	Restaurant	Street vendors	Restaurant	Street vendors	Restaurant	Street vendors	Restaurant	Street vendors
	Mean ± S.D	Mean ± S.D	Mean ± S.D	Mean ± S.D	Mean ± S.D	Mean ± S.D	Mean ± S.D	Mean ± S.D	Mean ± S.D	Mean ± S.D
Cadmium(cd)	0.044*± 0.010	0.174**± 0.010	0.035**± .010	0.135**± 0.026	.020**±.0.01	0.179*± 0.060	0.040*± .216	0.209*± 0.056	0.056*±0.035	0.256±0.191
Lead(pb)	0.316*± 0.059	1.226**± 0.059	0.411*±0.161	1.1731**±0.161	0.444*± 0.146	1.238**± 0.140	0.631*±0.078	1.2501*±0.243	0.350*±0.080	1.489**±0.767
Mercury(Hg)	0.232± 0.080	0.296 ± 0.112	0.354*±0.124	0.408*±0.145	0.216*±0.061	0.365*±0.114	0.286*±0.070	0.302±0.180	0.358±0.086	0.379±0.081
Copper(Cu)	0.191±0.053	0.302±0.082	0.220*±0.081	0.292±0.049	0.112±0.021	0.282±0.020	0.080±0.015	0.379±0.134	0.205±0.029	0.302±0.083
Nickle(Ni)	0.094*± 0.048	0.160± 0.010	0.111*±0.023	0.189*±0.070	0.060*±0.008	0.161**±0.050	0.091*±0.019	0.197**±0.098	0.147*±0.147	0.160**±0.023
Zinc(Zn)	1.162**± 0.042	2.139**± 0.842	1.834**±0.716	2.862**±0.200	1.539**±0.675	2.689**±0.214	1.330**±0.106	1.948**±0.852	1.424**±0.067	2.139**±0.842

* There was a significant difference between Means at $p \leq 0.05$

** There was a highly significant difference between Means at $p \leq 0.05$

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الملخص العربى

بقايا بعض المعادن الثقيلة فى الأغذية السريعة (الجاهزة للأكل) المجمعة من محافظ الإسكندرية

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مركز البحوث الزراعية - الإسكندرية - القاهرة

لقد أجريت الدراسة على بعض أنواع من الأغذية السريعة الجاهزة للأكل (سندوتشات الشاورما والسجق والهامبورجر والكفتة والكبدة) المجمعة من المطاعم والباعة الجائلين المنتشرة بمحافظة الإسكندرية وذلك لتقدير مستويات المعادن الثقيلة وتشمل الكادميوم والرصاص والزئبق والنحاس والنيكل والزنك وقد أسفرت الدراسة عن النتائج التالية :

١- كانت متوسطات تركيزات المعادن الثقيلة فى بعض أنواع من الأغذية السريعة الجاهزة للأكل (سندوتشات الشاورما والسجق والهامبورجر والكفتة والكبدة) المجمعة من المطاعم فى الحدود المسموح بها بينما كانت متوسطات تركيزات الكادميوم والرصاص فى العينات موضع الدراسة من الباعة الجائلين أعلى من الحدود المسموح بها.

٢- كما أوضحت الدراسة أن أعلى متوسط تركيز للكادميوم فى سندوتشات الكبدة من المطاعم (0.056±0.035) بينما كان أقل تركيز له فى الهامبورجر (0.020±0.01).

٣- وفى حالة الرصاص فإن أعلى متوسط تركيز كان فى سندوتشات الكفتة من المطاعم (0.631±0.078) بينما أقل تركيز (0.316±0.059) كان فى سندوتشات الشاورما على التوالى.

٤- وفى حالة الزئبق كان متوسط تركيزات الزئبق فى جميع العينات موضع الدراسة فى الحدود المسموح بها.

٥- وكان أعلى تركيز للنحاس والنيكل والزنك 0.220±0.081, 0.147±0.081, 1.834±0.716 جزء المليون فى سندوتشات السجق والكبدة والسجق من المطاعم على التوالى.

٦- هذا وقد أسفرت الدراسة أن أعلى تركيز للكادميوم والرصاص فى سندوتشات الكبدة المجمعة من الباعة الجائلين (1.489*±0.767, 0.256±0.191) جزء فى المليون.

٧- وفى حالة الزئبق فإن سندوتشات الهامبورجر من الباعة الجائلين سجلت أعلى متوسط (0.408*±0.145) جزء فى الملبون.

٨- كما أوضحت الدراسة أن أعلى متوسط تركيز للنحاس والنيكل (0.379±0.134, 0.197±0.098) كان فى سندوتشات الكفتة من الباعة الجائلين.

٩- وفى حالة الزنك فإن سندوتشات السجق سجلت أعلى متوسط تركيز (2.862±0.200) جزء فى المليون.