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DETECTION OF SOME TOXIC HEAVY METALS IN MEAT AND OFFAL OF SLAUGHTERED CATTLE IN TANTA ABATTOIR, GHARBIA GOVERNORATE.

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ABSTRACT

A lot of one hundred and twenty random samples of meat, liver and kidney were collected from young and old slaughtered cattle (20 of each) at Tanta slaughter house, Gharbia governorate, Egypt, for detection of some heavy metal residues as Lead, cadmium and mercury by using Atomic absorption spectrometer. The results revealed that the highest mean value of lead concentration was recorded as 0.606 $\pm$ 0.190 mg/kg wet weight in weight in old slaughtered cattle liver, while the lowest mean value of lead concentration was 0.036 $\pm$ 0.016 mg/ kg wet weight in meat samples of young slaughtered cattle. More over, the highest mean value of cadmium concentration was recorded in as slaughtered cattle 1.752 $\pm$ 0.469 mg/kg wet weight in kidney sample, while the lowest value of cadmium level in young slaughtered cattle was 0.858 $\pm$ 0.133 mg/kg wet weight in meat samples.

Regarding the mercury concentration in slaughtered cattle the highest level was recorded in liver of old aged cattle 0.499 $\pm$ 0.171 mg/kg wet weight, whilemean the lowest results were recorded in meat sample of young aged slaughtered cattle as 0.218 + 0.041, All the obtained results of lead, cadmium and mercury were compared with the permissible limsts of FAO/WHO (1992) and ES (1993) and public health hazards of such toxic heavy metals were discussed. Hygienic measures and awareness programs were implemented to avoid contamination of meat and offal with such toxic heavy meals.

INTRODUCTION

Heavy metal pollution is considered as one of the most important environmental problems in Egypt, it results from industrial and agricultural wastes that spread in air, water and soil, these pollutants have tendency to accumulate in tissues and organs of animals, birds, fish and human being.

Cumulative toxic effect of heavy metals are recognized due to low elimination rates from the body and cause serious health hazard to man depending on their level of contamination (Massadeh & Snook, 2002 and Lars, 2003).

Consumers have specific concerns about food contaminants but often lack the means to make appropriate judgments on what is high risk and what is not contaminants in food can be grouped according to their origin and nature. Environmental contaminants of food safety concern include toxic metals and elements, organometallic compounds agricultural chemicals. These contaminants may present a potential hazard for human health if exposure exceeds tolerable levels **(Turiszerletics and Pakto, 2008).**

Beef cattle may be exposed to a high quantity of toxic metals in the environment by air, water and ingestion of polluted feeds. Fortunately, these animals act as a very efficient biological filter against heavy metal concentrations where it is valid when the animals grazing near motor ways and roads with heavy cars traffic **(Carl, 1991).** Feeding animals with forage produced in contaminated areas results in increasing the concentration of each heavy metals, consequently, milk and meat production **(Marack et al., 1998; Massani et al., 2001; Tariova, 2001 and Jarup, 2003).**

Heavy metals are persistent types of pollutants which cannot be destroyed by heat treatments or environmental degradation, so their persistence enhance their potential to reach and effect human being **(Levensen and Barnard, 1998 and Cibulka et al., 1989)**

Lead, cadmium and mercury belong to the group of environmental contaminants which can enter the food chain and thus contaminant the food; they have, or may have toxic and / or oncogenic potential. Concentration of these elements in human food is restricted to quantities that are considered to be harmless, and regulated by specific act of laws.

Mercury has long been known as toxic environmental pollutant presenting an occupational. The increased use of mercury in industrial processes, as a fungicide and increased reports of mercury poisoning in human have prompted this concern **(Centers for Disease Control and Prevention, 2005)**. Animal may be exposed to air borne mercury or it may enter the body through contaminated water or feed **(Cang et al., 2004).**

The objective of this stuffy was to estimate the mean level of lead, cadmium and mercury in meat, livers and kidneys in young and old slaughtered cattle and compared with the permissible limits of Egyptian organization standards.

MATERIAL AND METHODS

1- Collection of samples:

one- hundred and twenty random samples of meat, livers and kidneys were collected from young and old slaughtered cattle (20 of each) and the collected samples were analyzed to estimate the level of lead, cadmium and mercury residues by Atomic absorption spectrometer (Spectra- AA10, USA).

Reagents:

All regents used were of he highest available purity. Digestion mixture consisted of 60 ml of HNO_3 and 40 ml of $HClO_4$.

1- Instrument used

A Perkin Elmer model (Spectra-AA10, USA) flame atomic absorption spectrometer (AAS) with computer system was employed throughout the experiment for determination of lead, cadmium and mercury. The concentrations of heavy metals in the solutions were determined by AAS which was adjusted at wave lengths of 283.3nm, 228.8nm and 253.7 nm for Pb, Cd and Hg, respectively. Absorbance and concentration were recorded on the digital scale of the AAS, the examined samples were calculated as ppm (mg/kg) on wet weight.

3- Washing Procedures:

washing of the glassware and plastic film is an important process to avoid any sort of contamination especially when trace elements or heavy metals are analyzed. The test tubes, Polyethylene tubes and glassware were soaked in water and soap for 2 hours then rinsed sacral times with tap water.

After that glassware has been rinsed once with distilled water then with wet mixture (consisting of 520m deionized water, 200 m concentrated HCI and 80 ml H_2O_2) then once with washing acid (10% HNO_3)and finally washed with deionized water then air-dried in incubator away from contamination or dust **(El-Mowafi, 1995).**

4- Digestion procedures:

one gram of each sample was removed and taken by a sharp scalpel in a screw capped tube, 5ml of the digestion mixture were added to the tissue sample **(Clark 1998).** The tubes were tightly closed and the contents were vigorously shaken and allowed to stand overnight.

Then, the tubes were heated for 3 hours in water bath adjusted at 70^{o}C to ensure complete digestion of the sample. The digestion tubes were vigorously shaked at 30 min. intervals during the heating period. Finally the tubes were cooled at room temperature and then diluted with 5 ml demonized water, and filtered through filtered paper (Wattman No.42). the filtrate was collected in polyethylene tubes. These tubes kept at room temperature until analyzed, then capped with polyethylene film and kept a room temperature until analyzed for Pb, Cd and Hg contents **(Seady, 2001)**. Blanks and standard were prepared in the same manner as previous and by using the same chemicals.

RESULTS

Table (1) Statistical analytical results of lead concentration in the examined meat and offals of slaughtered cattle (n=20).

Age / Tissue	Young*			Old**		
	Min	Max	Mean + SE	Min	Max	Mean + SE
Meat	0.01	0.13	0.036 ± 0.016	0.04	0.18	0.061 ± 0.020
Liver	0.39	2.35	0.597 ± 0.179	0.08	1.75	0.606 ± 0.190
Kidney	0.19	1.61	0.482 ± 0.111	0.05	1.21	0.288 ± 0.134

* young age animal less than 5 years.

** old age animal more than 5 years.

Table (2) Comparison between incidence of lead in tissues of slaughtered cattle with maximum permissible limits of FAO/ WHO (1992) and ES (1993).

Tissue	Maximum permissible limits		Young		Old		Total	
			No	%	No	%	No	%
Meat	Es	0.1	0	0	0	0	0	0
	FAO/ WHO	0.05	7	35	5	25	12	30
Liver	Es	0.1	8	40	3	15	11	27.5
	FAO/ WHO	0.05	14	70	7	35	21	25.5
Kidney	Es	0.1	3	15	1	5	4	10
	FAO/ WHO	0.05	13	65	7	35	20	50

Table (3) Statistical analytical results of cadmium concentration in the examined meat and offals of slaughtered cattle (n=20).

Age / Tissue	Young			Old		
	Min	**Max**	**Mean ± SE**	**Min**	**Max**	**Mean ± SE**
Meat	0.40	1.31	0.858 ± 0.133	0.25	1.48	0.489 ± 0.175
Liver	1.58	2.67	2.106 ± 0.125	0.73	3.85	1.472 ± 0.411
Kidney	1.17	3.38	1.332 ± 0.313	0.98	4.39	1.752 ± 0.469

Table (4) Comparison between incidence of cadmium in tissues of slaughtered cattle with maximum permissible limits of FAO/ WHO (1992) and ES (1993).

Tissue	Maximum permissible limits		Young		Old		Total	
			No	**%**	**No**	**%**	**No**	**%**
Meat	Es	0.1	6	30	6	30	12	30
	FAO/ WHO	0.5	5	25	4	30	9	22.5
Liver	Es	0.1	7	35	7	35	14	35
	FAO/ WHO	0.5	7	35	7	35	14	35
Kidney	Es	2.0	7	35	6	30	13	32.5
	FAO/ WHO	0.5	11	55	7	35	18	45

Table (5) Statistical analytical results of mercury concentration in the examined meat and offals of slaughtered cattle (n=20).

Age / Tissue	Young			Old		
	Min	Max	Mean ± SE	Min	Max	Mean ± SE
Meat	0.13	0.3 b 7	0.218 ± 0.041	0.22	0.53	0.37 ± 0.090
Liver	0.42	1.29	0.859 ± 0.119	0.35	1.49	0.499 ± 0.171
Kidney	0.33	1.01	0.686 ± 0.045	0.28	1.02	0.615 ± 0.079

Table (6) Comparison between incidence of mercury in tissues of slaughtered cattle with maximum permissible limits of FAO/ WHO (1992) and ES (1993).

Tissue	Maximum permissible limits		Young		Old		Total	
			No	%	No	%	No	%
Meat	Es	0.5	0	0	1	5	5	2.5
	FAO/ WHO	0.5	0	0	1	5	5	2.5
Liver	Es	0.5	6	30	4	20	10	25
	FAO/ WHO	0.5	6	30	4	20	10	25
Kidney	Es	0.5	4	20	2	10	6	15
	FAO/ WHO	0.5	4	20	2	10	6	15

DISCUSSION

The highest mean value of Lead in young aged slaughtered cattle was 0.579 ± 0.179 mg/kg wet weight of liver sample, followed by kidney and meat sampled 0.482 ± 0.111 and 0.036 + 0.016 mg/kg wet weight, respectively, while the mean values of lead concentrations in liver, kidney of and meat were 0.606 ± 0.190, 0.288 ± 0.134 and 0.061 ± 0.020 mg/kg wet weight, respectively, nearly similar results were recorded by **El-Kelish (1995).** Found that mean lead concentration in muscle liver and kidney was 0.18 and 0.42 and 0.25 mg/kg in cattle carcasses, respectively, while **Ibrahim and Hassanein, (2001)** found that the mean value of lead concentration in beef was 0.885 + 0.062 ppm, and **Falandysz and Lorence (1991)** found the mean value of lead in fresh beef was 0.080 ppm. **El-Atabany (1995)** found that value of lead residues in muscle, liver and kidney of slaughtered cattle at Manzala abattoir were 0.18, 0.42 and 0.25 mg/g. respectively. **Thabet (2002)** found that mean value of lead were 2.638 ± 2.285, 2.329 ± 0.267 and 1.369 ± 0.15310 mg/g wet weight, respectively.

Regarding the results in Table (2) while 40% and 15% of examined liver of young and old ages slaughtered cattle were about the ES permissible limits (1993) and 15% and 5% of examined kidney sample for young and old slaughtered cattle, respectively were above the permissible limits of **ES (1993)** Comparing these results with **FAO/ WHO (1992)** revealed that 35%, 70% and 65% of young slaughtered cattle meat, liver and kidney, respectively, while was 25%, 35% for old slaughtered cattle meat, liver and kidney, respectively.

The above mentioned results revealed that aged slaughtered cattle have high concentration of lead residues in liver, kidney and meat than young one and this may be attributed to bioaccumulation of such residues in animal tissues and offals and the low rate of elimination from such organs **(Tahvonen, 1996).**

The major source of lead in the environment resulting from manufacture of alkyl lead fuel additives. Its transport and distribution from stationary and mobile sources mainly via air and probably discharged into soil and water **(WHO, 1977).** Lead can accumulate in tissues in cattle grazing close to smelting plants or in animals ingesting paints or substances high in lead content **(Gracy and Collins, 1992).**

Toxic effects of lead involve the nervous system, the liver, gene function, the composition of circulating blood, kidney function, the vitamin D endocrine system and bone. The provisional weekly intake of lead in food must not exceed than 0.005 ppm as recommended by **FAO/WHO (1989).**

Lead is recognized as known neurotoxicant and of major public health concern which causes both acute and chronic intoxication **(Gossel and Bricker, 1990).** The toxicity of lead could result in anemia, abdominal colic, liver dysfunction, renal damage, peripheral neuropathy in adults and CNS disorders in the form of permanent brain damage in children **(Shibamoto and Bejldanes, 1993).**

Lead pollution is multidimensional, including food processing techniques, traffic pollution and other factors. Lead poisoning is generally ranked as the most common environmental health hazard **(Goyer, 1991 and Adekunle and Akineymi 2004).**

The result which reported in Table (3) revealed that the highest mean value of cadmium concentration was 1.752 ± 0.469 mg/ kg in kidney sample from old slaughtered cattle followed by liver samples 1.472 ± 0.411 mg/ kg wet weight, while the mean value of meat samples of old slaughtered cattle was 0.489 ± 0.179 mg/ kg. while the mean value of cadmium concentration in kidney, liver and meat of young aged slaughtered cattle was 1.332 ± 0.313, 2.106 ± 0.125 and 0.858 ± 0.133 mg/ kg wet weight, respectively. **Flandysz and Lorence (1991)** noticed that mean value of cadmium for muscle, liver and kidney of cattle were 0.011, 0.077 and 0.36 mg/ kg wet weight, respectively, whole **El-Atabany (1995)** measured that levels of cadmium in muscle, liver and kidney of cattle as 0.11, 0.24 and 0.38 mg/kg wet weight.

Korenekova and Skalicka. (2002) mentioned that the highest mean value of cadmium recorded in the liver was 0.456, and in muscle was 0.126 mg/kg. **Thabet (2002)** revealed that mean value of cadmium in examined kidney, liver and muscle of cattle were 0.192 ± 0.023, 0.141 ± 0.018 and 0.092 ± 0.010 mg/g wet weigh, respectively.

The presence of cadmium in meat, kidney and liver samples of slaughtered cattle may be attributed to grazing of animals on sandy or textured soils phosphate fertilizers contained a high amount of cadmium associate with increase of cadmium in kidney tissues **(Grandjean, 1986 and Marcombe et al., 1994).** Greater ingestion of contaminated feeds and water and inhalation of fumes and dusts from the industrial activates results in high concentration of cadmium in tissues of lactating and beef animals **(Dwivedi et al., 1997).**

The high content cadmium concentration was recorded in kidney and this may be due to synthesis of metallothionein in renal cells which binds with cadmium (Jin at al., 1987).

The presence of SH group in cystine and methionein amino acids play an important role in diminishing cadmium binding in skeletal muscles **(Beveridge, 1974 and Carl, 1991)**

Cadmium is a cumulative poison and metabolically inhibit essential metabolic function of zinc, copper and iron and furthermore, it inhibits sulfhydral enzyme systems necessary for cellular metabolism **(Mousa and Samaha 1993).**

Moreover, comparision between incidence if cadmium in most of young and old slaughtered cattle revealed 30% of each exceed the maximum permissible limits of **ES (1993)** , while was 25% and 20% of young and old aged , respectivly , according to **FAO/WHO (1992)** . The same was recorded in liver samples of young and old slaughtered cattle where the cadmium level exceed the **ES (1993)** and **FAO/WHO (1992)** at the level 35% for all parameters under examinations, respectively. Kidney samples revealed high concentration of cadmium in young and old slaughtered comparing with **ES (1993)** at 35% and 30% , respectively while for **FAO/WHO**

(1992) were 55% and 35%, respectively as recorded table (4).

Cadmium Predominantly accumulates in the kidneys and the liver because its rate of elimination from these organs is relatively low, this is partly due to the binding of cadmium to metallothionein in these tissues **(Garcia-Fernadez et al.,1996).** Ingestion of meats or its organs contaminated with cadmium may lead to acute gastroenteritis **(Cibulka et al., 1989).** Moreover, cadmium may cause itai-itai or ouch-ouch disease as a result of renal failure **(Peter, 1993).**

Table (5) indicated that the highest mean value of mercury concentration was 0.499±0.171 and 0.859 ± 0.119 mg \kg wet weight, respectively in liver samples of old and young slaughtered cattle, while the lowest mean value was recorded as 0.218 ± 0.041 mg\kg and 0.37 ± 0.090 mg/kg wet weight in meat samples obtained from young and old slaughtered cattle, respectively.

The mean values of mercury residues in kidney samples were 0.686 ± 0.045 and 0.615 ± 0.079 mg\kg respectively, in young and old slaughtered cattle.

Jorhem et al.(1991) recorded that mean values of mercury in meat, liver and kidney were 0.005,0.006 and 0.01mg/kg,respectively.

Regardless the age of slaughtered cattle, only 2-5% meat samples, 25% liver samples and 15% of kidney samples exceed the maximum limits recommended **by Egyptian Organization for Standardization and Quality control (1993) and FAO / WHO (1992)** as recorded in table (6)

The variations observed in levels of mercury concentrations in this study may be attributed to differences in pastures, amount and types of feeds offered to animals. Excessive use of sludge as soil fertilizers may be a direct cause of elevated mercury residues in tissues of cattle **(Falandez, 1991)**. Cattle may be exposed to air born mercury or it may enter the body orally through contaminated water or feed **(Cang et al., 2004).**

Mercury is considered as a cumulative poisonous element because of its slow excretion from the intestine and kidney.

Periodical measuring of heavy metals in meat and edible organs, as well as awareness of public and consumers with hazards of heavy metals are considered as very important tools in reduction of heavy metal residues. however proper housing of cattle in clean places far away from industrial plants and high ways as well as proper covering of meat at shop can reduce up to 90% of heavy metals contamination from open air.

The obtained results were compared with safe levels of both **FAO/WHO (1992) and ES(1993),** on the other hand the bublic health hazards and hygienic mefasures to avoid the contamination of meat and offals were with toxic heavy metals was discussed.

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