RESIDUES OF SOME HEAVY METALS IN FRESHWATER FISH
(OREOCHROMIS NILOTICUS AND LABEO NILOTICUS)
IN ASSIUT CITY MARKETS

H. H. Essa* and H. Z. Rateb**

*Dept. of Food Hygiene, Animal Health Research institute Assiut, Egypt
**Dept. of Clinical Lab. Diagnosis. Faculty of Vet. Med., Assiut University

ABSTRACT:
This study was conducted to determine the residues of lead (Pb) cadmium (Cd) and mercury (Hg) in the muscles of the freshwater fish, 40 random samples (20 from Oreochromis niloticus and (20 from Labeo niloticus) were used and collected from different markets in Assiut City, Egypt. They were analyzed by using Ph meter Orion 920 research electrode. The results revealed that levels of Pb, Cd and Hg in the Oreochromis niloticus samples were 0.125 (0.046-1.126), 0.976 (0.198-1.938) ppm and 4.875 (3.686-7.220) µg/kg respectively. While the concentration of Pb, Cd and Hg in the Labeo niloticus sample were 0.119 (0.021-0.721), 0.621 (0.379-1.032) ppm and 4.039 (3.687-5.620) µg/kg respectively. The results of this study indicate that the Pb, Cd concentrations in all examined samples were lowered than the Egyptian Organization of Standardization and Quality Control (EOS/QC, 1993). The consumption of these contaminated fish regularly even in a small amounts for long time may lead to health troubles. Public health importance and the hazardous toxic effects of the examined heavy metals as well as the suggestive recommendation to reduce or control the sources of pollution to the fresh water fish with these metals were discussed.

INTRODUCTION:

From the public health stand point of view attention must be paid, not only to the study of the nutritional benefits of animal origin, but also to the safety aspects, especially those concerns with the presence of harmful pollutant substances to human health.

Heavy metals make up one of the most important group of pollutants. From the point of food analyst, heavy metals which are referred to the inorganic elements, metallic in nature had a hazardous effect even at relatively low concentration. Moreover, not broken down at all or may chelated over along time scale to become permanent additions to the environment and animal, and consequently to human tissues. These heavy metals are not needed as structural components of organs and tissues, not constituents of body fluids and not a constituent or activators of enzymes system in
body except traces of arsenic, which are needed in a very low concentration (Royal Commission on Environmental pollution, 1979).

Water pollution referred to the addition to the water of an excess of material that is harmful to humans, animals and fishes. The materials found in water and considered toxic to fishes in one way or another can be categorized into (oxygen debilitating materials, toxic materials, toxic gases, toxic organic compounds and pesticides (Omima, 2010).

Contamination of fish tissues by heavy metals is arisen mainly from the contamination of feed, water, air beside the accidental addition which can be associated with soils naturally high in these elements, environmental pollution from local industry, and feeding grain (Hecht, 1990). Thus heavy metals enter food chain and lead to unwanted residues in food animals. These residues have a pharmacological action and conversion products, then are transmitted to the target organs in the animal body which are mainly the edible affsl of the food animals (Gracey and Collins, 1992).

Heavy metals are undesirable and produce no lesion in animal tissues that can be observed post–mortem except in heavy intoxication (Royal Commission on Environmental Pollution, 1979). Heavy metals are persistent type of pollutants and can not be destroyed by heat treatment, so that their persistence enhances their potential to reach and affect the human being (Levensen and Barnard 1988). Excessive intake of heavy metals in food had led to many cases of intoxication, ranged between the gastrointestinal disturbance to liver and kidney dysfunction and lung carcinoma (Gracey and Collins, 1992).

Lead is one of the most toxic metals that has probably plagued humans since early civilization. The distribution of lead in the environment is a major health hazard and intoxication with lead may occurs as pandemics in human (Needlemon, 1980).

Lead is recognized as a known neurotoxicant with major public health concern which causes both acute and chronic intoxication (Gossel and Bricher, 1990). The toxicity may show in the form of anemia, abdominal colic, liver dysfunction, renal damage, peripheral neuropathy in adults, CNS disorders in the form of permanent brain damage in children and case of extreme lead poisoning, convulsion followed by coma and death, might occurred. Moreover lead had a biological half life of about 27 years in human bones (Shibamoto and Bjeldanes, 1993).

Cadmium intoxication in human resulted in renal damage and dystrophic changes associated with hypercalcuria, glucosuria, proteinuria and aminoaciduria with hypertension (Ragan and Mast, 1990, Carl, 1991, Gracey and Collins, 1992), and itai itai disease which characterized by sever pain, soft bones and the death may occur as a result of renal failure (FAO/WHO, 1972 and Peter, 1993). Also a dystrophic change in liver and testis (Gruenwedel, 1990; Gracey and Colins, 1992) associate with anemia (Robards and Worsfold, 1991) has been reported.
Cadmium contaminating air and water from industrial sources may be transmitted to man through contaminated food stuff (Carstensen and Poulsen, 1974). Generally, cadmium is virtually absent from the human body at birth and accumulates with age in the body tissues resulting in renal failure (Gracey and Collins, 1992).

Mercury is considered as one of the most impotent pollutant in our environment. Mining, smelting, industrial discharge, loss of mercury in water effluent from chloralkali plants, mercury in paper pulp industries and fossil fuel. It is estimated that about 5000 tons of mercury per year may be emitted from burning coal, natural gas and from the refining of petroleum products are considered as a main source of mercury in the environment (Goyer, 1996). Mercury is popular in agriculture because of its ability to counteract fungi and mold. It therefore has been widely used to prevent grain spoilage. In the form of pesticides (fungicides for seed dressing) and in industry as wood preservative, production of dyes, initial explosive in boosters and igniters (Bartik and Piskac, 1981, Gossel and Bricker, 1990).

Mercury has been recognized as severe environmental pollutant, with high toxicity even at low concentrations and it has the ability to enter into biological systems (Porto et al., 2005). It has strong tendency to accumulate in aquatic food chain, and about 95% of the methyl mercury in humans originated from ingested fish (Houserova et al., 2007; Voegborlo and Akagi, 2007). Methyl mercury is a neurological toxicants to humans. In addition, methyl mercury is also classified as a group of possible human carcinogen (Commission of the European Communities, 2001). Mercury has deleterious effects on the immune system, renal reproductive, CNS, heart, oral and gut bacteria (Hibberd et al., 1998).

During recent years the importance of mercury in the food chain has become better understood. Inorganic and organic mercury derivatives are arising as effluents from industrial processes and converted in the lakes and rivers into soluble methyl mercury. This is carried down to the sea, where it is taken by man and animal through drinking water or through eating fish.

The aim of the present study is to determine the lead, cadmium and mercury levels in fresh water fish (Oreochromis niloticus and Labeo niloticus) to ensure the safety to the consumer and direct the attention to their public health significance.

MATERIALS AND METHODS:
Collection of samples:
A total of 40 random meat samples of freshwater fish Oreochromis niloticus and Labeo niloticus (20 of each) were collected from different markets in Assiut City for determination of lead, cadmium and mercury levels.

Digestion of samples:
Five grams from each sample were digested by using a mixture of nitric and perchloric acids (Khan et al., 1995). Till use for determination.
Estimation of metals: Lead, cadmium and mercury were determined by using pH meter Orion 920 research electrode (USA).

RESULTS:

Table 1: Lead levels (ppm) in examined samples of *Oreochromis niloticus* and *Labeo niloticus*

<table>
<thead>
<tr>
<th>Examined Samples (Muscles)</th>
<th>Number of samples</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean ±S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Oreochromis niloticus</em></td>
<td>20</td>
<td>0.046</td>
<td>1.126</td>
<td>0.125 ± 0.024</td>
</tr>
<tr>
<td><em>Labeo niloticus</em></td>
<td>20</td>
<td>0.021</td>
<td>0.721</td>
<td>0.119 ± 0.025</td>
</tr>
</tbody>
</table>

Table 2: Cadmium levels (ppm) in examined samples of *Oreochromis niloticus* and *Labeo niloticus*

<table>
<thead>
<tr>
<th>Examined Samples (Muscles)</th>
<th>Number of samples</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean ±S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Oreochromis niloticus</em></td>
<td>20</td>
<td>0.198</td>
<td>1.938</td>
<td>0.976 ± 0.035</td>
</tr>
<tr>
<td><em>Labeo niloticus</em></td>
<td>20</td>
<td>0.379</td>
<td>1.032</td>
<td>0.621 ± 0.030</td>
</tr>
</tbody>
</table>

Table 3: Mercury levels (µg/kg) in examined samples of *Oreochromis niloticus* and *Labeo niloticus*

<table>
<thead>
<tr>
<th>Examined Samples (Muscles)</th>
<th>Number of samples</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean ±S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Oreochromis niloticus</em></td>
<td>20</td>
<td>3.686</td>
<td>7.220</td>
<td>4.875 ± 0.063</td>
</tr>
<tr>
<td><em>Labeo niloticus</em></td>
<td>20</td>
<td>3.687</td>
<td>5.620</td>
<td>4.039 ± 0.048</td>
</tr>
</tbody>
</table>

Table 4: Recommended levels of lead, cadmium and mercury in food

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td><em>Oreochromis niloticus</em></td>
<td>0.125±0.024</td>
<td>0.5 ppm</td>
<td>Pb level should not more than 0.05 ppm</td>
</tr>
<tr>
<td></td>
<td><em>Labeo niloticus</em></td>
<td>0.119±0.025</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadmium</td>
<td><em>Oreochromis niloticus</em></td>
<td>0.976±0.035</td>
<td>0.1 ppm</td>
<td>Cd should not exceed 0.05 ppm</td>
</tr>
<tr>
<td></td>
<td><em>Labeo niloticus</em></td>
<td>0.621±0.030</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td></td>
<td>4.875±0.063</td>
<td>5.00 µg/kg</td>
<td>Hg should not more than 5.00 µg/kg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.039±0.048</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EOSQC : Egyptian Organization for Standardization and Quality Control  
WHO : World Health Organization.

DISCUSSION:

Fish is widely consumed in many parts of the word by humans because it has high protein content, low saturated fat and also contain calcium, phosphorus, iron, trace elements like copper and a fair proportion of the B-vitamins known to support good health (Tucker, 1997).

Many reports on contamination of fish by chemicals in the environment were reported (Tuzen and Soylak, 2007). Heavy metals are considered the most important constituents of pollution from the aquatic environment and the sea due to toxicity and accumulation by marine organisms, such as fish (Inskip & Piotrowsiki, 1985 and Emami et al., 2005). While lead, cadmium and mercury can be tolerated at extremely low concentrations, they are extremely toxic, persistent and not easily
biodegradable (Ikem and Egiebor, 2005). High contaminated fish may cause health risk to human. The toxic effects of heavy metals, particularly lead, cadmium and mercury, have been broadly studied (Porto et al., 2005, Houserova et al., 2007; Catsiki and Strogyloudi, 1999). The major source of exposure of human to heavy metals through food ingestion (Ikem and Egiebor, 2005).

In the present study, the results in table 1 revealed that lead levels were 0.125 and 0.119 (ppm) in Oreochromis niloticus (Tilapia niloticus) and Labeo niloticus respectively. These results are nearly similar to that obtained by El Nabawi et al. (1987) who found lead level of 0.128 and 0.115 (ppm) in Tilapia niloticus and Tilapia zillii, but higher than the results recorded by Ekpo et al. (2008) who found that the mean value of lead in Tilapia zilli was 0.002 ppm. Our obtained results are higher than that recorded by Ebrahim et al. (2010). They found that lead level in canned fish was 0.096 ppm. The lead levels recorded in examined Oreochromis niloticus and Labeo niloticus samples exceeded the permissible limits of WHO (1984) which mentioned that lead level should not more than 0.05 ppm, but lead level in examined samples was lower than the permissible limits (0.5 ppm) recommended by Egyption Organization for Standardization and Quality Contral (EOSQC 1993), Table 4.

Chronic lead poisoning is characterized by neurological defects, renal tubular dysfunction and anemia. Damage of CNS is a marked feature especially in children (Underwood, 1977). In men, lead affects the male gametets resulting in sperm abnormalities and decreased sexual desire as well as sterility (Needleman and Landrigan, 1981). In women, lead poisoning is associated with abnormal ovarian cycles and menstrual disorders in addition to spontaneous abortion (Needleman et al., 1984).

The results in table 2 revealed that the mean cadmium level was 0.976 and 0.621 ppm in Oreochramis niloticus and Labeo niloticus respectively. These results are higher than the result found by Ekpo et al. (2008) and Ebrahim et al. (2010). They found that the mean value of cadmium was 0.001 ppm in Tilapia zilli and 0.050 ppm in canned fish respectively. But the obtained results was less than the result recorded by El Nabawi et al. (1987) who found that the cadmium level was 1.261 and 1.002 ppm in Tilapia niloticus and Tilapia zilli. The mean cadmium levels of examined Oreochromis niloticus and Labeo niloticus sample appeared to be within the permissible limits stipulated WHO (1984) which mentioned that the content of cadmium should not exceed 0.05 ppm. On the other hand the Egyptian Standard (1993) recommended that the concentration of cadmium should not exceed 0.1 ppm, Table 4. So the obtained results in this study (Table 2) for cadmium in Oreochromis niloticus and Labeo niloticus samples were within permissible limits.

In the present study, Hg increased in Oreochromis niloticus and Labeo niloticus of all examined samples. Generally the concentrations of mercury were high, recording on overall range of 3.686-7.220 µg/kg with mean value 4.875 µg/kg in Oreochromis niloticus and 3.687-
5.620 µg/kg with mean value 4.039 µg/kg in *Labeo niloticus* samples. The *Oreochromis niloticus* samples contained higher levels of mercury than that of *Labeo niloticus* samples (Table 3) the obtained results revealed that mercury levels were higher than to that obtained by Ekpo et al. (2008) who found that mercury level ranged from 2.010–4.401 µg/kg with mean value 3.125 µg/kg in *Tilapia zilli*. The mean mercury levels of examined *Oreochromis niloticus* and *Labeo niloticus* samples appeared to be within the permissible limits recorded by WHO (1984), which mentioned that the level of Hg should not more than 5.00 µg/kg. Table 4.

Mercury occurs widely in the biosphere and has long been known as a toxic element presenting occupational hazards associated with both ingestion and inhalation. No vital function for the element in living organisms has yet been found. The toxic properties of mercury have evoked increasing in recent years due to the extent of its use in industry and agriculture, and the recognition that alkyl derivatives of Hg are more toxic than most other chemical forms and can enter the food chain through the activity of microorganisms with the ability to methylate, the mercury present in industrial wastes (Underwood, 1977). Exposure to heavy metals such as cadmium and mercury is of immediate environmental concern. A direct relationship between heavy metal poisoning and thyroid dysfunction was reported in rabbits by Ghosh and Bhattacharya (1992).

This study improves the base line data and information on lead, cadmium and mercury concentration in freshwater fish (*Oreochromis niloticus* and *Labeo niloticus*) commonly marketed in Assiut City of Egypt. Such data provide valuable information on safety of fishes commonly consumed by the public.

REFERENCES:


EOSQC (Egyptian Organization for Standardization Quality and Control) (1993): Maximum level for heavy metal contaminants in food, ES No. 2360.


Ikem, A. and Egiebor, NO (2005): Assessment of trace elements in canned fishes (Mackerel, Tuna, Salmon, Sardines and...


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Methyl mercury and some residues
in fish from Nile and Lybian
banners in Asyut market.

Ramzi, Hossam and Hougham

The study aimed to estimate
levels of some residues:
mercury and cadmium,
arsenic and lead,
in fish samples from
markets in Asyut city.

The study was conducted on
40 samples, 20 samples of Nile
fish and 20 samples of Lybian
fish. The samples were
analysed using different
methods. The results show
that the mean level of
mercury was 0.125
million/mg in Nile fish,
and 0.119 million/mg in
Lybian fish. For cadmium,
the mean level was 0.046
million/mg in Nile fish,
and 0.021 million/mg in
Lybian fish. For arsenic,
the level was 0.976
millions in Nile fish,
and 0.976 millions in
Lybian fish. For lead,
the level was 0.379
millions in Nile fish,
and 0.379 millions in
Lybian fish.

The study results show
that the levels of these
residues are exceeding
the allowable limits in
some cases. The effects
of these residues can
damage the health of
consumers over time.

The study recommends
research on the
available sources
and remedies to
control these
outbreaks.