Assessment Of Lead Contamination In Kuwait With An Impact In The Internal Organs Of The Livestock

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ABSTRACT

One hundred and eighteen samples from the internal organs (kidney and liver) of the different species including Naeemi lambs, Australian lambs, camels, cows and a goat were collected and tested for lead level. These samples were collected from several slaughter houses in Kuwait that is in Dahar, Shuwaikh, Hawali and Jahra. Naeemi lambs tend to accumulate the highest lead level whereas Australian lambs accumulate the lowest level. In general kidney accumulate levels of lead that is higher than those accumulated in liver and that become significant in Naeemi lambs and in Dahar slaughter house in particular. Soil samples from several areas in Kuwait were collected and tested for lead concentration and found to reach up to 4700 mg/Kg and up to 5605 mg/Kg near the highways. These results explain the high level of lead accumulated in Naeemi lambs that is reared in Kuwait and exposed to the high levels of lead that is in the top soil of the area.

Key words: Lead, Kuwait, Naeemi, Kidney, Liver, soil, slaughter house.

Introduction

Lead is a naturally occurring bluish-gray metal found in small amounts in the earth’s crust. It has no characteristic taste or smell. It may be used in the form of metal, either pure or alloyed with other metals, or as chemical compounds, primarily oxides. The commercial importance of lead is based on its ease of casting, high density, low melting point, low strength, ease of fabrication, acid resistance, electrochemical reaction with sulfuric acid, and chemical stability in air, water, and soil (Biddle 1982).

Metallic lead does not dissolve in water or organic solvents, and does not burn. It is soluble in nitric acid and hot concentrated sulfuric acid. It is incompatible or reactive with strong oxidizers, hydrogen peroxide, chlorine trifluoride, zirconium disodium acetylide, and acids. It is a moderate fire hazard in the form of dust when exposed to heat or flame; it is a moderate explosion hazard in the form of dust when exposed to heat or flame. When heated, it emits highly toxic fumes; it can react vigorously with oxidizing materials.

Because of health concerns, lead from gasoline, paints and ceramic products (Stokinger 1981), caulking, and pipe solder has been dramatically reduced in recent years.

In general populations, lead may be present at hazardous concentrations in food, water, and air. Sources include paint, urban dust, and folk remedies. It is also a major potential public health risk. And the released lead in the environment can not be economically recovered and therefore remain as a potential hazard to health (Nariagu1990a). Lead poisoning is the leading environmentally induced illness in children. At greatest risk are children under the age of six because they are undergoing rapid neurological and physical development. Lead is well recognized as causing developmental and other problems. Lead has not been fully removed from most gasoline and it's still present in old paint and commonly in soil or dust around contaminated buildings, as well as in some window blinds and glazes on some pottery.

Lead damages the red blood cells, nervous system, kidneys, brain and other organs and its presence in these compartments is the major sign of lead toxicity (Bratton and Kowalczyk 1989). Young humans and animals, particularly those pregnant, are at the greatest risk of lead toxicity even when exposed to small amounts of lead (Carson et al 1973). There is no evidence that lead is carcinogenic to man but it is carcinogenic in high doses in animals (USPA 1980,Stokigner 1981). The absence of carcinogenicity in man due to the scarcity of cases that are exposed to high doses.

Living species could be exposed to lead via several ways like breathing workplace air in lead smelting, refining, and manufacturing industries. Another way by eating lead-based paint chips, drinking water that comes from lead pipes or lead soldered fittings. Breathing or ingesting contaminated soil, dust, air, or water near waste sites, breathing tobacco smoke and eating contaminated food grown on soil containing lead or food covered with lead-containing dust and breathing fumes or ingesting lead from hobbies that use lead (leded-
glass, ceramics) could be other ways of lead exposure. It does not move from soil to underground water or drinking water unless the water is acidic or "soft" (Tsuchiya 1977; USEPA 1980). It stays a long time in both soil and water.

Overexposure to lead is one of the most common overexposures found in industry. Lead overexposure is a leading cause of workplace illness. Therefore, (occupational safety and health administration) OSHA has established the reduction of lead exposure to be a high strategic priority. OSHA’s five year strategic plan sets a performance goal of a 15% reduction in the average severity of lead exposure or employee blood lead levels in selected industries and workplaces.

Lead is a systemic toxin that affects virtually every organ system, even at levels previously thought to be low. Lead is metabolized, absorbed, distributed and excreted. The rate depends on its chemical and physical form and on the physiological characteristics of the exposed person (e.g. nutritional status and age). Once in the blood, lead is distributed primarily among three compartments – blood, soft tissue (kidney, bone marrow, liver, and brain) and mineralizing tissue (bones and teeth). Absorption via the GI track following ingestion is highly dependent upon presence of levels of calcium, iron, fats and proteins. The most sensitive is the central nervous system, particularly in children. In the central nervous system it causes edema and its effect are often irreversible. The effects of lead are the same regardless of whether it enters the body through breathing or swallowing. If ingested, lead can accumulate in body organs, including the brain, and result in lead poisoning (plumbism) and even death. At high levels of exposure, lead can severely damage the brain and kidneys and the immune system of adults and children.

Sheep could be exposed to lead by eating contaminated plants, eating the soil itself, or breathing soil dust (Maine Soil Testing Services 1998). Through eating the meat and the internal organs of this animal and others human can be exposed to doses of lead that could be hazard on his life.

In this activity, I assessed the level of lead contamination in the soil dust in different parts of Kuwait and related that to the level that could be found in the internal organs of livestock since they are exposed to the dust by several ways in the environment.

Methodology:

Three hundred samples of top soil were collected from different parts of Kuwait to test the lead level contamination. Areas were selected carefully to represent most of the areas of Kuwait. Areas near high ways, intersections, bus stops and places where grazing sheep are seen. Dust particles (100 g) from the top of the soil were swept into a small plastic container. Each container was documented with location and date of collection.

Soil samples were dried at 50°C for seven days. Two grams of each sample was digested with a high purity nitric acid then was heated over a hot plate. The final solution is made with 5% nitric acid till the total solution become 25ml. Samples then were filtered using regular filter papers then analyzed for lead concentration by using inductively coupled - Plasma-Atomic emission spectrometer (ICP-AES).

Liver and kidney samples were collected from the slaughter houses while animals were being slaughtered (Dahar, Shuwaikh, Hawali and Jahra). Samples of the internal organs were kept in ice box and transferred to central analytical laboratory at KISR for lead concentration determination. Ten grams of the fresh frozen tissue samples were digested with nitric acid and perchloric acid in a beaker at 100°C heated to 180 °C. The final volume was made to 25 ml. Then the rest of the procedure of determination of lead level was the same as that of soil samples.

Data obtained for lead distribution were analyzed using the Student Numan -Keul method to determine significant differences between least squares means. The general linear model (GLM) of the statistical analysis system(SAS) was used. Least square means of lead concentration for different locations of the slaughter houses as well as different internal organ (liver and kidney) were calculated using all the main effects in the analysis. Simple means of lead levels were calculated for kidney and liver at each category of animal breed and slaughter house location to understand the differences within each category.

Results and Discussion

Soil samples were collected from several parts around Kuwait City. These samples were collected just to have an idea about the level of lead level in the topsoil to appreciate the consequent work. Lead levels, as was tested from several places in Kuwait City and even outside, reached up to 4700 mg/Kg. Near the highways, levels reached as high as 4943 mg/Kg ranging from 4600 to 5605 mg/Kg which is considered high if we compare it to places like united states and Europe. These have levels around 300-400 mg/kg which might be as a result of banning the leaded gasoline for almost more than a decade beside the wet nature of these areas that could help clean some of the tested areas. Such high levels of lead in the dust or the top soil, in Kuwait, makes
one concern specially if we know that Kuwait has a sandy nature and dust can be transferred from one place to another exposing humans and animals to the risk of breathing it and eating the contaminated food.

Liver and kidney samples from livestock from all over Kuwait's main slaughterhouses were collected. Samples were from livestock including local lambs; Australian lambs, goats, camels and calves slaughtered in the main slaughter houses in Kuwait. Samples collected from different locations differed in lead level (p =0.025) Table 1. Those internal organs that were collected from all locations were lower in lead concentration than those that were collected from Dhahar slaughterhouse. This was significant from those organs that was collected from Hawali slaughterhouse (P=0.0012). This could be because most of the animals that were slaughtered in Hawali are from the Australian (imported) ones while it is mostly local in Dhahar. Which a gain strengthen the theory of having contaminated environment with heavy metals locally. This was expected since the leaded gasoline is still widely used in Kuwait and pollution from this source could count much in the environment. In addition to the sand storm nature of Kuwaiti weather that could transfer the top soil and hence the toxic particles from one place to the other and expose the animals not only through pasture but also through out the respiratory tract. This will not affect the imported animals since they will not graze from the local pasture in the first place and the period of time from arrival to slaughter is short. That was not the case in Jahra. Although most of the slaughtered animals in jahra were local but they were lacking any significance in difference in lead level with Hawalli and Shuwaikh. That may due to the lower number of samples collected from Jahra that represent half of the least collected samples of the other locations.

Table 2 shows that levels of lead accumulated in Kidney were higher in than that in liver but the significance were not clear statistically. The superiority of lead level in kidney over the liver found in this work is consistent with those findings of Willoughby et al (1972a), Fick et al (1976), Suzuki and Yoshida (1979) Hamir et al (1981) and Pearl et al (1983). Lead levels in the liver and kidney from the collected samples reached up to 0.84 and 1.5 mg/Kg respectively. Provisional tolerable weekly intake of lead for a 70 Kg man will be about 1.75 mg (25microgram X 70 Kg) which will be exceeded by the intake of the existing lead levels in these samples when the consumer eats more than 1 Kg of the internal organ (liver and kidney) which is likely to be. Such organs are hazardous for human consumption at these levels of lead. Although these readings are the highest among these samples, the possibility is there to get contaminated internal organs among them in the normal situation.

Lead level accumulation in the liver and kidney is affected by the type of species and the breed within (P=0.03) Table 3. Naeemi lambs accumulate the highest level of lead in the liver and kidney. These levels were significantly higher than Australian lambs (P=0.009). These findings could be due to the contaminated environment that the local Naeemi breed is exposed to locally.

Table 4 showed that levels of lead accumulated in the kidney and liver of Naeemi lambs were higher than those that accumulated in the kidney of the other species (p < 0.05). The levels of lead accumulated in kidney but not liver in Dhahar higher than those accumulated in the same organs in the other slaughter houses locations. These results could be due to the higher number of local breeds that are slaughtered in Dhahar than the other locations. The difference were shown in kidney but not liver because the kidney is the primary route where lead goes.

Due to these findings a further investigation should be done in this field to clear any suspect in the safety of the slaughtered lambs in Kuwait that is reared locally. Larger number of samples should be used in the coming investigations and wider variety of internal organs should be checked in order to clear the unclear picture of food safety from the local source.

<table>
<thead>
<tr>
<th>Table 1: Least square means of lead concentration mg/Kg in the internal organs (liver and kidney) of different tested species (Naeemi lambs, Calves, Australian lambs, Camel and goats) slaughtered in different slaughterhouses (Dhahar, Shuwaikh, Hawalli and Jahra) in Kuwait.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slaughter House Location</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Dhahar a</td>
</tr>
<tr>
<td>Shuwaikh b</td>
</tr>
<tr>
<td>Hawalli c</td>
</tr>
<tr>
<td>Jahra b</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

a,b Mean in column with different superscripts differ (P<0.05)
Table 2: Least square means of lead concentration mg/Kg in the internal organs liver and kidney for different species slaughtered in Kuwait.

<table>
<thead>
<tr>
<th>Organ</th>
<th>Sample Number N</th>
<th>Lead Concentration mg/Kg</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kidney</td>
<td>61</td>
<td>0.192</td>
<td>0.057</td>
</tr>
<tr>
<td>Liver</td>
<td>57</td>
<td>0.163</td>
<td>0.055</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>118</td>
</tr>
</tbody>
</table>

Table 3: Least square means of lead concentration mg/Kg in the internal organs (liver and kidney) of different tested species (Naeemi lambs, Calves, Australian lambs, Camel and goats) slaughtered in different slaughterhouses in Kuwait.

<table>
<thead>
<tr>
<th>Slaughter House Location</th>
<th>Sample Number N</th>
<th>Lead Concentration mg/Kg</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naeemi</td>
<td>51</td>
<td>0.256</td>
<td>0.048</td>
</tr>
<tr>
<td>Calves</td>
<td>7</td>
<td>0.137</td>
<td>0.118</td>
</tr>
<tr>
<td>Australian</td>
<td>51</td>
<td>0.118</td>
<td>0.014</td>
</tr>
<tr>
<td>Camel</td>
<td>7</td>
<td>0.109</td>
<td>0.048</td>
</tr>
<tr>
<td>Goat</td>
<td>2</td>
<td>0.105</td>
<td>0.086</td>
</tr>
</tbody>
</table>

Table 4: Means of lead concentration mg/Kg in liver and kidney of different tested species in different slaughter house locations in Kuwait.

<table>
<thead>
<tr>
<th>Category</th>
<th>Organ</th>
<th>N</th>
<th>Lead Concentration mg/Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species/ Breed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naeemi Lamb</td>
<td>Kidney</td>
<td>26</td>
<td>0.310</td>
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<tr>
<td></td>
<td>Liver</td>
<td>24</td>
<td>0.222</td>
</tr>
<tr>
<td>Australian Lamb</td>
<td>Kidney</td>
<td>26</td>
<td>0.123</td>
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<tr>
<td></td>
<td>Liver</td>
<td>25</td>
<td>0.111</td>
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<tr>
<td></td>
<td>Kidney</td>
<td>3</td>
<td>0.053</td>
</tr>
<tr>
<td></td>
<td>Liver</td>
<td>4</td>
<td>0.150</td>
</tr>
<tr>
<td></td>
<td>Kidney</td>
<td>4</td>
<td>0.118</td>
</tr>
<tr>
<td></td>
<td>Liver</td>
<td>3</td>
<td>0.163</td>
</tr>
<tr>
<td></td>
<td>Kidney</td>
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<td>0.160</td>
</tr>
<tr>
<td></td>
<td>Liver</td>
<td>1</td>
<td>0.050</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>118</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dahar</td>
<td>Kidney</td>
<td>10</td>
<td>0.369</td>
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<tr>
<td></td>
<td>Liver</td>
<td>10</td>
<td>0.257</td>
</tr>
<tr>
<td>Shuwaikh</td>
<td>Kidney</td>
<td>31</td>
<td>0.168</td>
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<tr>
<td></td>
<td>Liver</td>
<td>29</td>
<td>0.184</td>
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<tr>
<td></td>
<td>Kidney</td>
<td>15</td>
<td>0.152</td>
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<td></td>
<td>Liver</td>
<td>12</td>
<td>0.710</td>
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<tr>
<td></td>
<td>Kidney</td>
<td>5</td>
<td>0.102</td>
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<tr>
<td></td>
<td>Liver</td>
<td>6</td>
<td>0.087</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>118</td>
<td></td>
</tr>
</tbody>
</table>
References


Carson, L.J., Harry V. Ellis and Joy L. McCann, 1973. Toxicology and Biological Monitoring of Metals in Humans. 3rd edition. Lewis Publisher, INC.


