CONTAMINATION OF FOOD WITH Pb

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ABSTRACT: *Lead is a chemical that does not affect the functioning of the human body and is toxic if it is in a high concentration. In plant products it concentrates on the leaves. It has been used over time as a preservative and sweetener of wines and dishes. The food comes through the processing of crop products grown on surfaces close to industrialized and high-traffic areas, lead-based food additives, coastal marine waters polluted with lead-containing products, consumption of animal food, alcoholic beverages deposited in pottery varnished with lakes containing lead or fraudulent distillation using machine radiators, lead insecticides, machinery, plumbing, containers and pipes made of lead or covered with lead lead, lead-rich alloys, tinplate, enamel clay, combustion of wood from demolition, lead painting, etc. The manifestations of lead poisoning are: malaise, asthenia, weakness, joint pain and muscular pain, various digestive disorders, but over time, the disorder is accentuated, the lead acts as: digestive tract (anorexia, vomiting, abdominal colic, stomach ulcer) nervous system, endocrine and osteo-articular, cardiovascular, renal and reproductive apparatus, immunological and humoral mechanisms.*

KEY WORDS: *contamination, lead, food, environment, toxicity*

1. INTRODUCTION

Depending on their role in the human body, metals are classified into three main groups:

- essential = trace elements or microelements (absolutely necessary for the organism): Cr, Fe, F, I, Co, Se, Zn, Sn
- semiesentials (exist in any organism, but have no clearly defined functions): Al, Ba, Br, Si, As
- nonessential (does not influence body function and are toxic if it is in high concentration): **Pb**, Cd, Hg

Heavy metals have a high toxic potential and pose a great danger to the environment and to the health of animals and humans as a result of their participation in the food chain. The impurities of heavy metals from the soil, water, air, reached on the surface of plant products are absorbed by plants and concentrated in certain areas: tubers (arsenic, selenium, molybdenum, antimony, chromium), leaves (selenium, **lead**, antimony, mercury, molybdenum), fruits (molybdenum, nickel).

Vegetable products in areas polluted with Pb or from roadside can concentrate 8-10 times more Pb than plant products in unpolluted areas.

Lead is a chemical with a metal character located in group A-IV A. It is naturally found in the form of minerals: galena (PbS), ceruzit (PbCo3). It's a gray metal,brilliant,which in the presence of air loses its gloss, of soft consistency, with low chemical reactivity and good resistance to acids. Lead is a heavy metal, gray-silver color, with very high density. It is a dense, ductile, very soft, extremely malleable metal, which has a poor electrical conductivity compared to other metals. Lead is very resistant to corrosion and is used in the construction of corrosive containers. Since it is not a constituent of

living matter, lead is considered a non-essential element in human nutrition and an animal and a major contaminant of the environment (fig. 1).

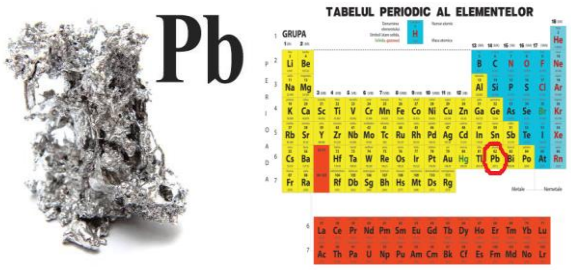

Figure 1. Lead

2. USE OF LEAD IN DIET THROUGHOUT HISTORY

In the Roman Empire, Pb was used in installations, but also as a preservative for food and drink. The Romans used lead acetate (lead sugar) as a preservative and sweetener of wines and meals.

If metallic lead is be heated in contact with air, is formed at its surface yellowish-red crystals (lead oxide or *litharge*). Litarga was used by the Romans to prepare lead sugar. Lignar dust = lead oxide reacts with acids, resulting in lead sugar = lead acetate, a substance that is sweet.

$Pb \rightarrow PbO$ (by heating the metallic Pb in the air, at 600 degrees C)

$PbO + 2CH_3COOH \rightarrow Pb(CH_3COO)_2 + H_2O$

Discovering that Pb turns the juice into syrup, Romanians used to boil must (grape juice) in lead vessels, until a viscous and sweet liquid is obtained which is called *sapa* and contained 1g of lead sugar / 1l of juice. This syrup was used as a sweetener in many recipes and as a preservative of wine. To avoid oxidation of wine and the conversion of wine alcohol to vinegar by the microbes in wine, use lead oxide, which preserves wine by neutralizing the vinegar (acid) that had already formed, forming lead sugar and the destruction of microbes. The need to conserve wine, which was the basic drink throughout the historical periods, was so strong, that even after the toxicity of the litharge has been demonstrated, in the 18th century, its use continued until the period in which the death penalty was applied for those who used litharga.

Many historians believe that, the fall of the Roman aristocracy are the major neurological damage which would have caused exposure to lead.The demigods of Roman emperors, such as Caligula, Nero, and Commodus, were the result of excessive use of wine preserved and sweetened with lead. Colic from Devonshire is a disease caused by lead intoxication which the people of Devon, Great Britain, suffered, in the 17th and 18th centuries.The first mention of colic dates back to 1655. Symptoms have started with severe abdominal pain, the disease being deadly.Cider, apple wine,is the traditional drink of devonians, and the connection between colic and cider drink has been observed over time, but the cause was discovered around 1760, when dr. George Baker has issued the hypothesis of a lead poison related to cider,noting that the symptoms of colic were similar to those of lead poisoning.

Lead was used in the cider production process, in that the presses and cleaning utensils were made of Pb. He did chemical tests and demonstrated the presence of lead in apple juice. The publication of the results was met with great hostility on the part of the cider producers. Over time, lead has been removed from the cider production process and colic has not appeared (fig. 2.)

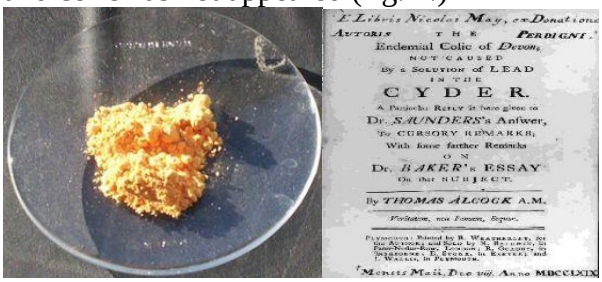

Figure 2. Litarga (lead oxide) used in the production of apple cider and the study of the appearance of the colony epidemic in Devon, due to Pb poisoning

3. Pb SOURCES IN FOOD

- products of plant origin grown on nearby surfaces of industrialized areas (metallurgy,

accumulators, fossil fuel thermal power industry) and heavy-duty motor vehicles (lead tetraethyl ether used as a gasoline additive); in the early 1970, 2 -4 g of Pb / 4 l of petrol were used; beans and maize growing in rural areas contain a level of 0.04-0.26 ppm, and if they are grown in the highway area, they contain 10 times more

- food additives containing lead (talc, various acidic solutions, organic acids) (for example: forging the red pepper stick with red lead oxide)
- hunting which contains lead allies
- coastal marine waters, polluted with products containing lead (fish, crustaceans, molluscs may reach levels of 0.2-2.5 mg / kg; the natural level of Pb in marine fish is 0.3 ppb); tonal analysis shows that its canning process increases the Pb level in it
- fodder and grass consumed by animals (meat and organs may have levels below 0.2 mg / kg)
- alcoholic beverages (liqueurs, cider, wine) stored in ceramic pots varnished with lacquers containing lead or fraudulent distillates using car radiators
- insecticides containing lead (lead arsenite) used in fruit growing and viticulture; lead arseniate is a stable and insoluble, high retention pesticide used in fairly high concentrations of 125 mg / m2 in agriculture, when sprinkling grapes; thus, the must obtained from these grapes contains 10-20 ppm arsenic lead, but the wine loses Pb from the solution by coupling with protein (decantation) and subsequent insolubilization
- machines, sanitary facilities, containers and pipes made of lead or lead-tinned (high-hard water corrodes the pipes, due to the formation of an insulating film insoluble lead salts; low water hardness corrodes the pipes and increases the lead concentration by 10-30 times (1-4 ppm); carbon dioxide-rich waters accelerate corrosion, the lead concentration reaching 4-8 ppm, which led to the ban on the production of Pb siphon heads and the use of Pb pipes in mineral and carbonated bottling plants)
- lead-rich alloys (70-80% lead) with which the kitchen utensils are glued, tableware and the longitudinal flap of the cans; sodium chloride solutions and food acids (tartaric, lactic, citric, acetic, maleic, gallic) accelerates the solubilization process of lead soldering who process acidic foods (beer, juices, wine, brandy) the lead concentration reaching 5-10 ppm
- foil sheets containing 1-10% lead, used for food packaging (use of lead tin as a protective material for iron or copper packaging, leads to an increase in the lead concentration in this alloy (up to 30%) and strong lead contamination (5-100 ppm) of acidic or salt-rich foods)
- enamel of clay pots, obtained hand crafted by melting at 1200 degrees Celsius of a mixture of silicon dioxide (sand) with lead oxides (litharge) (if you do not respect the proportion of sand / lead oxides, in the sense of increasing the concentration of oxides to obtain a brighter glaze, at lower combustion temperatures, but which is less stable to acid corrosion, due to the excess of unbound silicon oxides slightly soluble in acidic foods; following analyzes,concentrations of 7-8 ppm in yoghurt or 20-30 ppm were determined in foods prepared by adding vinegar)
- combustion of wood obtained during demolitions, which was dyed with paint based on lead (fig. 3.)

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Figure 3. Pb sources in food

Thus, they can be contaminated with lead, the following foods:milk, meat, crustaceans, molluscs, cephalopods, cereals, vegetables, fruits, cereals, mushrooms, potatoes, leafy vegetables, fats and oils, fruit juices, wines, water.

At the age of 60, the accumulation of lead in the body, mainly in bones, may reach 230 mg. Intoxication with Pb produce disease ***lead poisoning.*** Leadage of lead feed increases lead much more than air pollution. For Pb and other heavy metals *the daily allowable dose* was discarded and *a weekly tolerable dose* was administered.The amount of lead ingested admitted as a tolerable dose = 3mg / day. The total amount of ingested Pb in food = 0, 2-0.4 mg / day,and water = 0.1 mg / day.

The lead limits in food in Romania in mg / kg are: 0.1 (food fats, alcoholic beverages), 0.2 (milk), 0.3 (distilled natural alcoholic beverages and soft drinks), 0.4 (melted cheese), 0.5 (meat, salted fish, bread and bakery products, tomato juice, compotes, nectars, pasteurized fruit juice, confectionery), 0,6 (cheeses), 0,75 (marmalade, jams, jams, syrup), 1 (meat and vegetables, tomato paste, spicy sauces, concentrated grape must, dehydrated vegetables and fruits, concentrated soups, sugary products, cocoa, chocolate), 1,5 (canned fish, tomato paste, paste and fruit concentrates) .

In a UK study it has been shown that the average levels of lead in the blood of mothers and children in Pb-dwelling homes,were more than twice as big than those in dwellings which use copper pipes. Replacing installations in Pb has produced a 50% decrease in the average levels of Pb in the blood, reaching levels comparable to those of those who use copper pipes.

In Germany, in 2005-2007, a study was conducted on Pb in drinking water. In this regard,2901 drinking water samples from households were harvested. Following analyzes, it has been demonstrated that 7.5% exceeded the limit of 0.010 mg / l and 3.3% exceeded the 0.025 mg / l limit, imposed by German law on drinking water.

In another study made in Germany two categories were examined of drinking water samples and given that the maximum recommended by the World Health Organization for lead concentration of drinking water = 0.01 mg / l, the following were demonstrated:

- a first category (after the water stagnated all night on the pipes); of the 1434 stagnant water samples, 3.1% had a Pb concentration> 0.010 mg / l
- the second category (randomly harvested during the day); of the 1474 samples taken during the day, 2.1% had a concentration of Pb> 0.010 mg / l

4. LEAD TOXICOLOGY

Ingestion of lead in food is 0.2-0.4 mg / day, and in water of 0.01 mg / day. In the case of mild poisoning (0.2-2 mg / day in an adult) there are measurable effects in the blood, where the lead level is 20-30 mg / 100 ml.

The lead ingested with food arrives in the gastrointestinal tract. Absorption is influenced of chemical form where it is found: of organic compounds which contain (tetraethyl lead), the lead is absorbed in proportion of over 90% in the body and accumulates in bones, organs (liver, kidney), muscle tissue and central nervous system.

Lead absorbed is excreted in urine (75%) or faeces (16%). Lead absorption in the body is higher for diets with lower calcium and iron levels. As an antidote to lead intoxications milk is given.

The stages of lead poisoning are as follows:

- *Stage I* - characterized by anemia, due to reduced life span of erythrocytes and reduction of hemoglobin synthesis. It affects

enzymes which interfere with the haematopoietic system (amino-levulinic acid synthase, ALA-dehydrase and ferrochelate), increases uroporhyrin III in the blood, ALA in the urine and subtract the hematocrit and blood hemoglobin.

- *Stage II* - symptomatic, is characterized by disorders of the central nervous system, hyperreactivity, impulsive behavior, changes in perception, lessening of learning capacity, anxiety, irritability, headache, muscle tremors, ataxia, memory loss.
- *Stage III* - is characterized by renal failure, convulsions, coma and death.

Lead is a cumulative poison, children up to 6 years, fetus and pregnant women being the most exposed to Pb poisoning. It can reach the fetus through the mother's placenta and can cause severe damage to the nervous system and brain.

Initially, the manifestations are: malaise, asthenia, slimming, joint and muscle pain, various digestive disorders. Over time, the disorder is increasing, the lead acting on:

- *digestive tract* (anorexia, vomiting, abdominal colic, gastric ulcer)
- *nervous system* (irritability, insomnia, dizziness, headache, intellectual development disorder, reflex exaggeration, paresis, sensory disorders, adults who have been exposed to lead during childhood they have a lower volume of the brain, the existence of lead in the blood of children is correlated with decreased intelligence, decreased attention, lowering skills in writing and computing, emotional and social issues)
- *osteo-articular system*
- *cardiovascular system* (high blood pressure, coronary heart disease, irregular pulse, heart attack, and when days of ozone and fine particles in the air are higher, people exposed to lead have a higher risk of heart failure)
- *renal apparatus*
- *endocrine system* (with negative impact on fertility)
- *immunological and humoral mechanisms*
- *reproductive apparatus* (dysfunctions in the number, motility and morphology of sperm in men and the imminence of abortion, premature birth and low birth weight in women; pregnant women with a blood lead concentration of 0.014 mg / dl are exposed four times more at premature delivery than those having a concentration of 0.008 mg / dl)

4. CONCLUSIONS

1.Lead is not a constituent of living matter and is considered a non-essential element in human nutrition and a major contaminant of the environment.

2. In the Roman Empire, Pb was used in installations, but also as a preservative for food and drink.

3. It gets in food by processing products of plant origin cultivated on surfaces close to industrialized areas and heavy-duty vehicles, lead-based food additives, coastal marine waters polluted with lead-containing products, animal feed, alcoholic beverages varnished with varnish containing lead or fraudulent distillates using radiators automobile, lead-containing insecticides, machinery, plumbing, containers and pipes made of lead or lead-tin, lead-rich alloys, tin foil, clay enamel, combustion of wood from demolitions painted with paint lead base, etc.

4. The following foods can be contaminated with lead: milk, meat, crustaceans, molluscs, cephalopods, cereals, vegetables, fruits, cereals, mushrooms, potatoes, leaf vegetables, fats and oils, fruit juices, wines, water.

5. Lead ingested with food arrives in the gastrointestinal tract,and intoxication with Pb causes the disease lead poisoning.
6. The amount of lead ingested admitted as a tolerable dose = 3mg / day. The total amount of ingested Pb in food = 0, 2-0.4 mg / day, and from water = 0.1 mg / day.
7. Manifestations of lead poisoning are: malaise, asthenia, slimming, joint and muscle pain, various digestive disorders, but over time, the disorder is increased, the lead acting on: digestive tract (anorexia, vomiting, abdominal colic, stomach ulcer) , endocrine and osteo-articular, cardiovascular, renal and reproductive apparatus, immunological and humoral mechanisms.

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