

A REVIEW BASED ON THE RESULTS OF HEAVY METALS (Lead, Cd) OBTAINED FROM THE ANALYSIS OF ANIMAL FOOD PRODUCTS FROM MEAT IN SOME EUROPEAN COUNTRIES

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This review paper has the following purposes:

- *To highlight the importance of heavy metals and their presence in animal bodies and in their food products;*
- *To reveal the main sources of heavy metals;*
- *To speak about specific organizations that have the significant role of constantly monitoring the levels of heavy metals (and not only);*
- *To present the main method of analysis used in Europe (details for Romania's most often method)*
- *To present the samples' results which were obtained in some European countries (and, of course, our results)*
- *To answer this question: What should we do?*

Therefore, it is very important to continually assess the levels of these analytes (Lead, Cadmium and others) to ensure that the values fall within the maximum admissible limits.


Introduction

The importance of heavy metals and their presence in animal bodies and in their food products; the main sources


***Definition:* Heavy metals such as cadmium and lead are natural occurring chemical compounds.**



Sources:

- **Residues** - Human activity: *farming, industry or car exhausts* (automotive gasoline piston engines, oil burners, lead pipes, incinerators, industrial effluents and smokestack fallout)  *Soil, water, atmosphere*

These sources of toxic metals could be very well attributed to high accumulation of metals from the environment onto plants, municipal wastes, lead and nickel-cadmium batteries which are non-responsibly discarded.

- **Contamination:** during food processing and storage  *the ingestion of contaminated food or water, which is the main source of Lead (Pb) and Cadmium (Cd) intake.*

Food production methods: there have been discovered higher levels of heavy metals such as lead and cadmium in **canned meat products**, especially regarding the imports.

The road from the nutrition to the intoxication...

- **Human nutrition** depends on ensuring the optimal development of the organism during growth, as well as the gaining and maintaining of the body's resistance to external factors.
- **Meat** is very important in our food diet because, for most of us, it represents the main element in our nutrition. Naturally, heavy metals are not found in the animal body or in the animal food products, but they can be discovered as a result of their conscious or accidental incorporation (**contamination**) in food and which, by exceeding the acceptable limits can constitute a **health risk factor**.

Even low concentrations of heavy metals



Accumulation



Harmful effects over time

Legislation

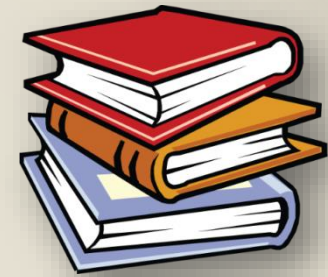
- **Specific organizations (FAO, WHO)** - role of constantly monitoring the :

♥ levels of heavy metals (COMMISSION REGULATION No. 1881/2006 setting maximum levels for certain contaminants in foodstuff) and

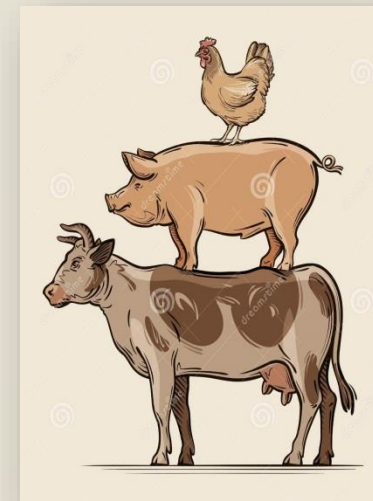
♥ their consequences for human health (if the maximum admissible limits imposed by European legislation are exceeded). Their surveillance has an important role to safeguard consumers in case of a food contamination incident. They address issues such as sustainability, biological diversity, climate and nutritional changes, population growth, water supply and access to food.

- Many food products (animal + non-animal) are **regularly tested** for a selection of trace elements to estimate possible nutritional or toxicological associations and to warrant agreement with government regulations or food safety.
- The concentration of the distinct element species in food is also required to estimate the food safety and nutritional quality.

Materials and methods



- In order to gather the most relevant articles for the target subject, I focused my attention on literature restricted in this domain, using the following keywords: *lead, cadmium, meat products, organs, graphite furnace atomic absorption spectrophotometry (GFAAS), dietary intakes (PubMed, Science Direct)*.
- We selected those samples that were analyzed by **GFAAS** and **FAAS** techniques in order to create a database at least for some European countries regarding heavy metals concentrations (Lead, Cd) in meat food products.
- For this purpose, muscle and organ samples from **pork, beef and chicken** from different farms and retail markets all over were randomly gathered.
All the samples were taken in different times and seasons.



Results on beef



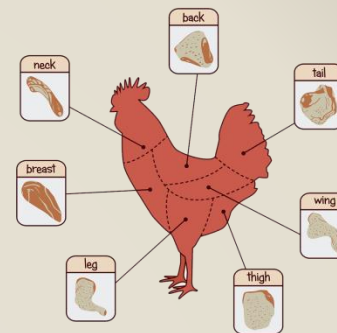
COUNTRY	SPECIES - BEEF											
	Muscle				Organs							
					Liver				Kidney			
	Lead (ppm)		Cd (ppm)		Lead (ppm)		Cd (ppm)		Lead (ppm)		Cd (ppm)	
FINLAND	0,010	0,10	< LOD	0,050	0,037	0,50	0,066	0,50		0,50		1,0
SWEDEN	< 0,005	0,10	0,001	0,050	0,0047	0,50	0,070	0,50	0,097	0,50	0,39	1,0
SLOVENIA	0,05	0,10	0,004	0,050	0,10	0,50	0,094	0,50	0,14	0,50	0,373	1,0
CROATIA	0,221	0,10	0,028	0,050	0,273	0,50	0,047	0,50	0,244	0,50	0,114	1,0
ROMANIA	0,025	0,10	< LOD	0,050				0,50	0,07	0,50		

Results on pork



COUNTRY	SPECIES - PORK											
	Muscle				Organs							
					Liver				Kidney			
	Lead (ppm)		Cd (ppm)		Lead (ppm)		Cd (ppm)		Lead (ppm)		Cd (ppm)	
FINLAND	0,009	0,10		0,050	0,011	0,50	0,066	0,50		0,50		1,0
SWEDEN	< 0,005	0,10	0,001	0,050	0,019	0,50	0,019	0,50	0,016	0,50	0,11	1,0
SLOVENIA	< 0,05	0,10	0,010	0,050	0,06	0,50	0,088	0,50	0,06	0,50	0,393	1,0
CROATIA		0,10		0,050		0,50		0,50	0,244	0,50	0,114	1,0
ROMANIA	0,05	0,10	0,003	0,050				0,50	0,2	0,50		

Results on chicken



COUNTRY	SPECIES - CHICKEN											
	Muscle				Organs							
					Liver				Kidney			
	Lead (ppm)		Cd (ppm)		Lead (ppm)		Cd (ppm)		Lead (ppm)		Cd (ppm)	
FINLAND	0,05	0,10		0,050	0,800	0,50	0,066	0,50		0,50		1,0
SWEDEN	< 0,005	0,10	0,001	0,050	0,700	0,50	0,019	0,50	0,016	0,50	0,11	1,0
SLOVENIA	< 0,07	0,10	0,020	0,050		0,50		0,50	0,06	0,50	0,393	1,0
CROATIA		0,10		0,050		0,50		0,50	0,244	0,50	0,114	1,0
ROMANIA	0,05	0,10	0,008	0,050				0,50	0,2	0,50		

The main method of heavy metals' analysis used in Romania



- **the most common method of analysis = Graphite Furnace Atomic Absorbtion Spectrometry.** We use this method, too, in the Sanitary Veterinary and Food Safety Laboratory - Prahova – my workplace. Steps:

1. Weight a certain amount of sample depending on the validated method
2. Completely calcinate the samples at 450 degree Celsius (50 C/hour)
3. Recalcinate them if it's necessary (adding 5 ml of hydrogen peroxide 30%)
4. The mineralizates are processed:
 - Add 5 ml of hydrochloric acid 6 Mol/l / each sample
 - Dry the samples on the sand bath
 - Add 10 ml of 0,1 HNO₃ / each sample
 - The porcelain crucible are carefully rotated, so the entire ash to come into contact with the acid
 - Each crucible is covered with a watch bottle and allowed to sit for about 1 hour
 - After this, the samples are processed by GF AAS.



Results and discussions



- **Cadmium** and **lead** can enter food either through *environmental processes* (as residues) or through *contamination* in processing and/or packaging (as contaminants). Therefore, it is very important **to accurately measure even low levels** of these heavy metals in many food matrices, because of the bioaccumulation process and, obviously, the negative health impacts they can induce.
- Determinations of these heavy metals were made in order to assess the threat to people posed by their presence. I have processed and interpreted all the relevant data regarding this subject, in order to highlight **their serious potential consequences.**



Anatomo-pathological changes

LEAD

Fetus and infants:

- The main toxic effect is the dysfunction of the nervous system;
- Reductions in cognitive development and intellectual performance (children).

Adults:

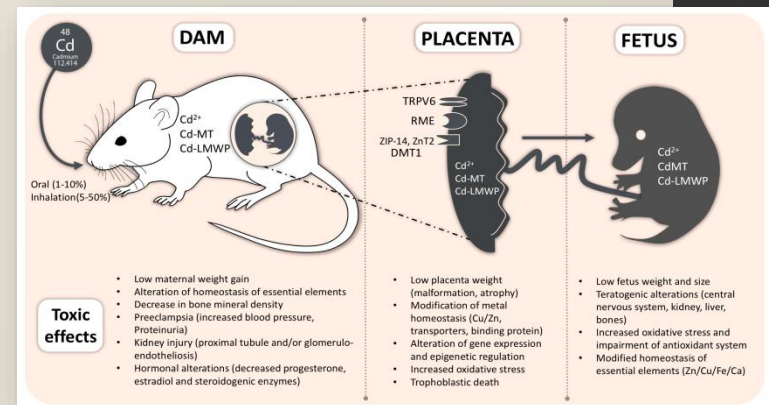
- blood-side effects;
- reproductive dysfunction;
- gastrointestinal damage;
- nephropathy;
- central damage as well as the peripheral nervous system;
- cardiovascular diseases in adults;
- arteriosclerosis, inhibition of growth, damage or inhibition of the activity of the immune system depending on the dose.



CADMIUM

- renal dysfunction;
- bone diseases;
- reproductive system deficiencies;
- pulmonary lesions (including lung tumors);
- skeletal changes in professionally exposed populations.

Cadmium is relatively poorly absorbed in the body, but once absorbed, it is slowly excreted, just like the other heavy metals.



Conclusions - *What should we do?*

- **The high industrialization rate** can be considered responsible for the contamination with many toxic elements such as Lead and Cadmium. They can be moved away by the air and can be deposited in soil, water, and unfortunately in the plants that the ruminants feed with.
- **Excessive consumption of offals** originated from animals raised in Pb contaminated environment **should be discouraged**. According to several studies, the high accumulation of such metals in the **liver** and **kidney** was found to be directly related to their function as **storage** and **excretory organ**, respectively.
- Furthermore, **garlic** could be advised to antagonize Pb toxicity, as garlic contains **chelating compounds** capable of enhancing elimination of Pb.
- Regarding all of these health risk factors, both animal breeders and final consumers of animal and non-animal products should **constantly monitor** and assess the levels of toxic metals in the environment and food in order to highlight the degree of contamination and its sources. By doing this, people will be able to take **measures in controlling these levels in the future**.

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Thank you for your attention!

