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Studies Regarding the Heavy Metal and Cadmium Content in Pressed Cheeses

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Abstract. The investigation was intended to determine the contents of heavy metals (mercury, lead, copper, zinc, selenium, cadmium) and arsenic in 3 sorts of pressed cheese (Dalia, Rucăr, Penteleu) manufactured in five milk processing units.

Keywords: heavy metals, arsenic, atomic absorption spectro-photometry (AAS), electromagnetic radiations, hollow cathode lamp.

INTRODUCTION

The heavy metals can get in our food through various ways; some of them may reach in the animal and human body in amounts exceeding certain limits and may determine toxic conditions. The food can be contaminated directly with certain toxic metals during processing, from the processing equipment, during preservation, transport, from the packing materials [1, 2, 4].

Bovines are exposed to undesired concentrations of *mercury* after ingesting cereals and seeds treated with mercury compounds, fish flour with mercury, mercury ointments used irrationally, and from here comes the possibility for mercury to pass into the milk.

The animals which fodder on plants contaminated with exhaust gas from vehicles, toxic substances coming from mining exploitations shall contain *lead* in their body, lead which shall be eliminated through the milk.

The sources of food contamination with *copper* are phyto-sanitary treatments with copper-containing pesticides. Copper also passes into the milk during processing, from processing equipment made of copper as a result of the corrosion process.

Excessive *zinc* may come from one of numerous sources: medicines overdose or nutritional overdoses, industrial emissions, use of insect fungicides with zinc, zinc covered tanks or galvanized tanks. The more the milk is kept in zinc covered tanks, the higher the contents of zinc.

Selenium may get into the milk through the food chain or through inappropriately applied treatments. Because it accumulates and it is eliminated very slowly especially through milk, it is recommended that animals are not treated with selenium 50 – 60 days before slaughtering. The milk with selenium contents is excluded from consumption and from industrial processing because even in amounts of 0.011 – 0.067 mg selenium /l it is toxic.

The main sources of milk pollution with *cadmium* are: the excessive use of cadmium superphosphates, exhaust gas from Diesel motors, the use of cadmium containing pharmaceutical products, the use of enamel which contains cadmium.

The *arsenic* compounds may have various uses: the use as pesticides, growth bio-stimulator, the use for pharmaceutical purposes.

MATERIALS AND METHODS

Atomic absorption spectro-photometry was used in order to determine heavy metals.

The determination of the concentration of a chemical element from the cheese sample subject to the analyze was made by measuring the absorption of an electromagnetic radiation of a certain wavelength, when passing through an environment containing the free atoms of the element researched, in the form of evenly distributed vapors.

The flame created by the burning of a gaseous fuel in which the solution is pulverized prepared from the sample subject to the analyses, is the environment in which the atoms from the sample solution are released. The electromagnetic radiation passing through the environment containing the sample is supplied by a special radiation source called hollow cathode lamp. The cathode of this lamp is built from the element which is to be determined. For each chemical element a special lamp is required.

The *instrumentation* is represented by the atomic absorption spectrophotometer, hollow cathode lamps (for each element studied), electric, thermally adjustable drying chamber and thermally adjustable calcination oven. As reagents are used chlorine hydride 20% solution, de-ionized water and standard solutions are prepared for the researched elements.

For all chemical elements except for the mercury, dry mineralization of the cheese sample was used (through calcination at 450 ± 25°C). 25 ml HCl were added (diluted 1:4 with de-ionized water) over the resulted ashes in a measuring flask and then it was brought to the sign with de-ionized water. As witness sample (blanc) de-ionized water was considered.

For the determination the instrument was set, the absorption of the standard solution was measured for the researched element and then the absorption of the sample solution. The standard curve was drawn for each series of determinations and for each element. The absorptions obtained were represented graphically depending of the concentration.

The researched metal contents expressed in mg for 1 kg of cheese (ppm) was calculated as follows:

$$M\ (mg/kg) = \frac{C \times V \times 1000}{m} \times 1000$$

where:

M – contents of studied metal;

C – amount read on the standard curve, in μg;

V – total volume of the sample solution;

m – mass of the sample analyzed.

In order to determinate *mercury*, wet mineralization was used additionally in special conditions and free of flame determination, using an atomization cell.

The contents in mercury, expressed in mg, for 1 kg of cheese (ppm) was calculated as follows:

$$Hg\ (mg/kg) = \frac{C \times 1000}{m} \times 1000$$

where:

C – amount read on the standard curve, in μg;

m – mass of the analyzed sample.

In the determination of *arsenic* there are certain peculiarities, i.e.: the arsenic in the sample is subject to an oxidation-reduction process through which hydrogen arsenate is formed, which is then drawn with air into a flame of argon-hydrogen where it is subject to atomization.

The contents in arsenic, expressed in mg for 1 kg of cheese (ppm) was calculated as follows:

$$As\,(mg/kg) = \frac{C \times 1000}{m} \times 1000$$

where:

C - amount read on the standard curve, in μg;

m - mass of the analyzed sample.

RESULTS AND DISCUSSIONS

Tab. 1

The variation boundaries of the contents in certain heavy metals and arsenic in the studied pressed cheese samples (ppm)

Crt. No.	Sort of pressed cheese	Nr. Of samples	Heavy metals (ppm)												Arsenic (ppm)	
			Selenium		Mercury		Cadmium		Lead		Copper		Zinc			
			abs.	pres.	0-0.05	> 0.05	0-0.05	> 0.05	0-0.5	> 0.5	0-2.5	> 2.5	0-25	> 25	0-0.15	> 0.15
1.	Penteleu	40	40	-	40	-	40	-	40	-	40	-	40	-	40	-
2.	Rucăr	40	40	-	40	-	40	-	40	-	40	-	40	-	40	-
3.	Dalia	40	40	-	40	-	40	-	40	-	40	-	40	-	40	-
TOTAL		120	120	-	120	-	120	-	120	-	120	-	120	-	120	-
%		100	100	-	100	-	100	-	100	-	100	-	100	-	100	-

A total number of 120 samples of pressed cheese were analyzed, 40 samples for each of the sorts: Penteleu, Rucăr, Dalia. The respective presses cheese sorts were obtained in 5 milk processing units.

From the information presented in Tab. 1 it can be noticed that *heavy metals* (selenium, mercury, cadmium, plumb, copper and zinc) and *arsenic* amounts in the studied pressed cheese samples were situated lower than the maximum admissible limit or were absent.

Selenium was absent in every analyzed sample.

Because of its toxicity, the milk and dairy products must be free of this toxic element.

The contents of mercury in the 120 analyzed samples was situated between 0 and 0.05 ppm. Considering the potential toxicity of lead, it was established that the weekly dose which is tolerable temporarily is of 0.3 mg Hg for an adult. The tolerance of the mercury residues is in rapid decrease, many countries (S.U.A., Japan) are imposing a tolerance of 0.05 ppm or less [2].

The cadmium contents in the analyzed samples was situated between 0 and 0.05 ppm.

Being an element with high and cumulative toxic potential, the restrictions in the therapeutic use are very severe. The maximum admitted limit for cadmium residues in cheeses is of 0.05 ppm.

The lead contents in the analyzed samples was situated between 0 and 0.5 ppm

The maximum admitted limit of lead residue in hard cheeses is of 0.5 ppm

The copper contents in the analyzed copper samples was situated between 0 and 2.5 ppm

The maximum admitted limit of copper residue in hard cheeses is of 2.5 ppm

The zinc contents in the analyzed samples was situated between 0 and 25 ppm

The maximum admitted limit of zinc residue in hard cheeses is 25 p.p.m

The contents of arsenic in the analyzed samples was situated between 0 and 0.15 ppm

The tolerances for arsenic have extremely large variations, the toxic dosage for humans is depending on many factors. The trivalent compounds are very toxic, while arsenic in pure condition is non-toxic. The maximum admitted limit for the arsenic residues in cheese products is of 0.15 ppm.

CONCLUSIONS

In performing all these investigations we have minded the progresses made at international level, selecting state-of-the-art investigation means: atomic absorption spectro-photometry, the results allowing us to state following conclusions:

- ✓ the heavy metal concentrations (selenium, mercury, cadmium, lead, copper and zinc) and arsenic in the studied samples were below the maximum admitted limit or were even absent;
- ✓ the low levels of contaminants in the analyzed pressed cheese samples indicate a low level of contamination in the fodder fed to the bovine and hence, implicit, a low contamination level of the milk – raw material.

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