American Journal of Biochemistry and Biotechnology 4 (3): 273-276, 2008
ISSN 1553-3468

Effects of pollution on lead and cadmium concentration and correlation with biochemical parameters in blood of human population nearby Kosovo thermo power plants

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Abstract: This study describes an investigation of lead and cadmium pollution of Kosovo environment as a result of outflow from the coal processing industry. In a comparative study of lead and cadmium concentration in blood of human population of two different environments in Kosovo, one nearby Kosovo Thermo Power Plants, (Obiliq) a highly polluted environment and the other that is considered as relatively clean rural environment (Dragash). Analysis has shown that emission of particulate in fly ash from Thermo Power Plants during 2005 has exceeded EU standards by 400-500% and that lead concentration was 18mg kg^{-1} and cadmium concentration was <0.5 mg kg^{-1} of ash. A series of determinations of lead and cadmium concentrations in blood of population that lives in this environment, have shown direct effects in biochemical parameters CRE (Creatinin), DB (Direct Bilirubine), TB (Total Bilirubine), AST (Aspartat Aminotransferaza), CK (Creatin Kinaza) and CHE (Cholenisteraza) in human organism. The results that were achieved in this study showed a significant difference in average lead and cadmium concentration in the blood of the investigated group of peoples that lives in the area near by the Power Plants, from a control group that lives in a rural unpolluted environment. Lead and cadmium has been analyzed in 50 samples taken from persons from industrial zone and 25 samples in controlled group. The level of lead concentration was 23.0-112.1 μg L^{-1} in geometric average 46.05 μg L^{-1}, cadmium concentration was 0.44-6.02 μg L^{-1} in geometric average of 1.56μg L^{-1}. Controlled group from the rural relatively clean environment showed lead concentration of 6.7-33.8 μg L^{-1} in geometric avarage 17.76 μg L^{-1} and cadmium concentration of 0.21-1.8 μg L^{-1} or in geometric average of 0.73 μg L^{-1}. In conclusion in exposed subjects, pollution from coal burning in Power Plant is very important factor for level of lead and cadmium concentration in blood of tested population.

Key words: Blood, lead, cadmium, biochemical parameters, correlation

INTRODUCTION

Kosova possesses a considerable energy potential of coal (lignite), which is mainly used to produce electricity. Today in Kosova, coal is excavated only in the Prishtina Pool, Surface Mines in Bardh and Mirash, which lay in a open surface, 10-15 km far from Prishtina.

The fact that the coal contain many trace elements in it, potentially toxic, such as As, Be, Cd, Hg and Pb, as well as the fact that better part of the coal excavated in Kosova (85%) is burned to produce electricity, increased the attention at the scientific institutions for deep knowledge regarding the presence of such elements in the coal in Kosova. Since the coal is the main national luxuriance of Kosova, it constitute about 50% of the value of natural wealth, it was studied broadly especially during last decades[1,2,3,4,5,6]. During the burning process of fossil fuel, of coal, better part of mineral elements transforms in bottom ash, which cause problems also regarding environment pollution. The smallest crumbs of ash, called flying ash, exits from the furnace and in the advanced technological system they are accumulated effectively in the related collector.

But, in the countries with older technology for coal burning, even with normal technology, great amount of flying ash are spread in atmosphere, where they cause huge damage for human health and in general to the vegetative and animal world. Measurements have shown that emission of the crumbs of flying ash from Thermo Power Plant Kosova B during 2005 overpass the EU standards for 400-500%.

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Last content analyses of the samples of the bottom ash and flying ash in the Thermo Power Plant of Kosova have shown that the concentration of the lead in the bottore ass is 16 mg kg^{-1}, whereas the concentration of cadmium is <0.5mg kg^{-1}. In the flying ass the concentration of the lead is 18 mg kg^{-1}, whereas the concentration of the cadmium is <0.5mg kg^{-1}.

MATERIALS AND METHODS

For the investigaten were taken 50 blood samples of the citizens from the industrial area of Obiliq, of different ages and genders, who are treated as investigated group (IG) in this project and 25 blood samples of the citizens from the Municipality of Dragash (environment without pollution), also of different ages and genders, control-Comparative Group (CG).

Preparation of the sample for determination of lead and cadmium in blood, in monovets were put 4.9 ml dilution solution (Triton X-100 0.01% and nitric acid 0.1%) and 100µl blood, the sample was centrifuged in 2500 rpm for 45 min. after this samples were put in auto-sampler cells and the measurement with SAAFG is performed[6,7,8,9].

For elimination of different obstacles during the phase of measurement of absorbing signal in graphite tube were used different modificatory matrix, as $NH_4H_2PO_4$ or $(NH_4)_2HPO_4$. Biochemical parameters were determined with BECKMAN COULTER Syncron CX7, monovet with blood samples were centrifuged for 10 min 4500 rpm^{-1}, serum is divided and is proceeded for analyses.

RESULTS AND DISCUSSION

Industrial area of Obiliq Kosova Termo Power Plant is located about 3 km far from Prishtina. In this locality, the most important activities from the environment point of view are coal mines (lignite) and produce of electricity.

The use of coal (lignite) sources for about 100 years with the high level of operation and produce of electricity for about 40 years continued without any great concern for the consequences in the environment. Since in the industrial area of Obiliq there is no other industry, Kosova power-stations and lignite mines are the biggest contaminants of the air in the country. Dust (flying ash) and bottom ash are the main components of the pollution of environment which reflects from the industrial area of Obiliq. These components itself

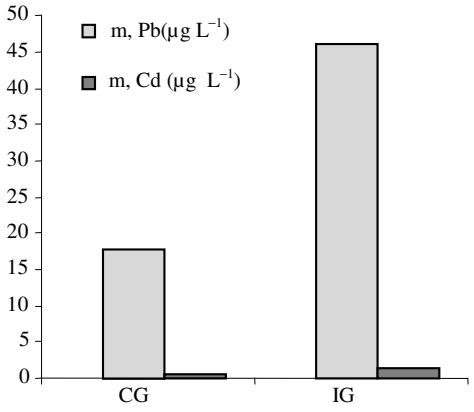

Fig. 1: Comparative of lead and cadmium level in blood between CG and IG

Table 1: Comparative of lead and cadmium level in blood between control group (CG) and investigated group (IG)

	CG	IG
m, Pb(µg L^{-1})	17.76	46.05
DS	1.7515	3.8411
p	<0.0001	
t	–6.61	
m, Cd(µg L^{-1})	0.73	1.56
DS	0.4331	1.2566
t	0.0006	
t	–3.34	

Table 2: Correlation between Pb and Cd of CG

	Pb,ug L^{-1}	Cd,ug L^{-1}	
n	25	25	
m	17.796	0.7312	
DS	3.9932	0.4331	
R	0.023	p	0.9100
GS	±0.4423		

Table 3: Correlation between Pb and Cd at the IG

	Pb,ug L^{-1}	Cd,ug L^{-1}	
n	50	50	
m	46.054	1.5628	
DS	6.0315	1.214	
r	0.124	p	0.3801
GS	±1.2173		

contain elements with high toxic potential as As, Be, Cd, Hg and Pb[1,2,3,4,5,6]. The results achieved with the analyses of blood samples of the human population of investigated group, (industrial area Thermo Power Plants Kosova) were compared with the results of the blood samples of human control group (control group is the locality in Dragash, highland municipality with clean environment, without pollution). Results of this investigation shows, Table 1 and Fig. 1, that there exists significant distinction in the average of the

Table 4: Correlation between Pb and biochemical parameters at the CG and IG

Pb	CG				IG			
	n	m	r	p	n	m	r	p
CRE	25	85.2	0.086	0.3428	50	84.1	0.245	0.0587
DB	25	0.48	0.184	0.1887	50	0.96	0.478	0.0006
TB	25	11.0	0.033	0.4371	50	10.0	0.323	0.018
AST	25	23.32	–0.125	0.2771	50	18.59	0.397	0.0045
CK	25	105	–0.15	0.2363	50	122.8	0.362	0.0091
CHE	25	166.2	0.317	0.0616	50	190.8	0.274	0.0397

Note: (n-number of samples, m-average of concentration, r-correlation index and p-probability)

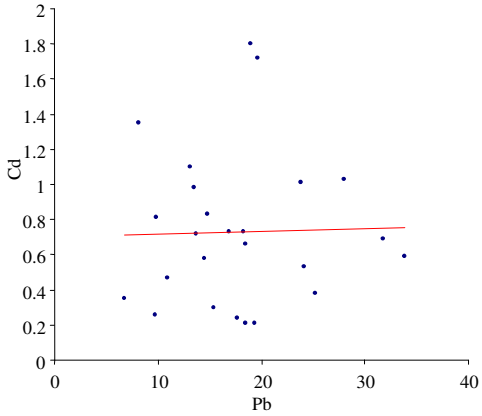

Fig. 2: Correlation between Pb and Cd of CG

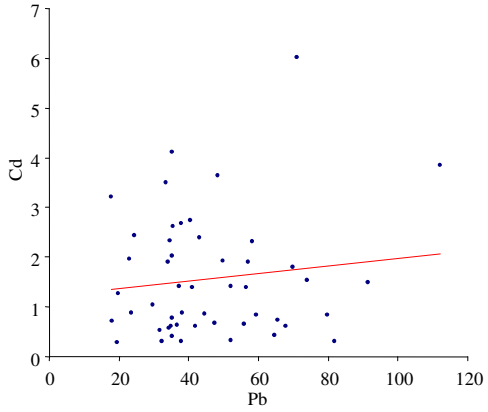

Fig. 3: Correlation between Pb and Cd at IG

concentration of the lead and cadmium in blood at the investigated group with the average of the concentration of the lead and cadmium in the blood at the control group, this difference is as a result of the pollution of environment in the investigated locality.

Except direct influence of the pollution of environment in the concentration of lead and cadmium in blood, in this investigation was analyzed also the correlation between lead and biochemical parameters in blood.

From the results presented in the Table 4 we see that between lead and biochemical parameters as CRE, DB, TB, AST, CK and CHE at the investigated group exists correlation with high statistical probability (progressive correlation), does not exist such correlation where as control group.

The correlation between lead and biochemical parameters is explained with the harmful effect of the lead in tissue, vital organs and in its inhibitory role in different biochemical reactions that catalyzed enzymes.

The correlation between lead and creatinin-CRE at the investigated group is in the limit of statistical probability ($p = 0.05$) parameters, which reflects as a result of the damage of muscles, eventually of kidneys[10,11]. Table 2 and Fig. 2 and 3, shows that does not exist statistical correlation between lead and cadmium in blood and this was proved at the control group as well as at the investigated group.

Table 2 and Fig. 2, Between Pb and Cd does not exist statistical correlation at the control group. In the Table 3 and Fig. 3 is presented the correlation between Pb and Cd at the investigated group, in which does not exist the correlation with statistical probability.

The correlation between lead with direct bilirubine-DB ($p = 0.0006$) and total bilirubine-TB ($p = 0.018$), at the investigated group can be explained with the fact respectively the effect of lead in acceleration of erythrocytes hemolize[11] and resuls with such correlation, which correlation does not exist at the control group.

The correlation between lead and aspartat aminotransferaza-AST ($p = 0.0045$), at the investigated group is with high statistical probability.

The correlation between lead and creatin kinaza-CK ($p = 0.0091$), at the investigated group is as a result of harmful effect of lead in muscles and central neural system[10]. At the control group does not exist such statistical relation. The correlation between lead and CHE ($p = 0.0397$), in the theoretical aspect, can be explained with the paralyzed role of the lead in the cellular level, as well as the inhibitor effect level of cholinesterase receivers[10,11].

CONCLUSION

There is a direct effect of environment in the concentration of lead and cadmium in blood at the human population of industrial area of Obiliq. Concentration of lead in the blood of investigated group is evidently higher than at the control group ($t = -6.61$, $p = <0.0001$), also the concentration of the cadmium in blood of the investigated group is higher than at the control group ($t = -3.34$, $p = 0.0006$). Between concentration of the lead and cadmium in the blood at the control group and investigated group does not exist statistical correlation. There is progressive correlation with statistical probability between lead and biochemical parameters (CRE, DB, TB, AST, CK and CHE) at the investigated group, whereas at the control group does not exist such correlation.

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