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Consequences of potassium dichromate intake on proteic profile in female rats, *Rattus norvegicus* (six months exposure)

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Abstract. The study carried out on 28 white Wistar adult female rats, divided in 3 experimental (E) groups, exposed for 6 months to 25ppmCr – LOAEL(E1), 50 ppm Cr (E2), 75 ppm Cr (E3) and one control (C) group - tap water, pointed out: significant decrease of total protein seric level below the bottom value of the physiologic limits, inversely correlated with the exposure level; significant decrease of albumin and globulin seric level, inversely correlated with the exposure level; significant increase of urea and creatinine seric level (each exceeding the maximum physiological limit), directly correlated with the exposure level.
Key Words: chromium, rat, blood, health**.**

Sažetak. Istraživanje je provedeno na 28 odraslih bijelih ženki Wistar štakora, podijeljenih u tri eksperimentalne/pokusne grupe/skupine (E), izloženih u roku od 6 mjeseci na 25 ppm Cr-LOAEL (E1), 50 ppm Cr (E2), 75 ppm Cr (E3) te kontrolne skupine (C) - voda je iz slavine pokazala: da se značajno smanjuje razina serumskih proteina ispod minimalne vrijednosti psiholoških granica, u obrnutom suodnosu/korelaciji s razinom izloženosti; da se značajno snizuje razina seruma urina i kreatinina (svako nadmašuje maksimalnu vrijednost psiholoških granica), izravno korelirana/u izravnom suodnosu s razinom izloženosti.
Ključne riječi: krom, štakor, krv, zdravlje.

Introduction. Chromium is a trace element that is essential to human health. It is also widely used in various industries. Chromium exists in both metallic and valence states, the hexavalent chromium being the most toxic and carcinogenic (Coşier & Petrescu-Mag 2008; Beaver et al 2009; Raghunathan et al 2009; Toxicology Profile for Chromium, U.S. EPA 2001).

Systemic toxicity of hexavalent chromium, which is commonly seen after intentional exposure, causes intense gastrointestinal bleeding, renal failure, intravascular hemolysis, liver damage, shock, coma, and even death (Beaver et al 2009; Lin et al 2009; Parveen et al 2009; Fatima & Mahmood 2007).

Material and Method. The study was carried out on 28 white Wistar adult female rats, divided in three experimental (E) groups, exposed for six months via drinking water to 25 ppm Cr – LOAEL (E_1) (Toxicology Profile for Chromium, U.S. EPA, 2001), 50 ppm Cr – 2 X LOAEL (E_2), 75 ppm Cr – 3 X LOAEL (E_3) and one control (C) group which received tap water not containing chromium.

The female rats were fed with standard diets, corresponding to species and age.

Forages and water were *ad libitum*.

The seric level of total protein, albumin, globulin, urea, creatinine was determined by the multiparametric analyzer EOS Bravo Forte, Hospitex Diagnostics, wet chemistry, Hospitex Diagnostics reagents, at PFCI (International Research Platform), Timişoara.

The results were processed by ANOVA and Student's test.

All assays on animals were conduced in accordance with present laws regarding animal welfare and ethics in animal experiments (Directive 86/609 EEC/1986; Romanian Law 205/2004; Romanian Law 206/2004; Romanian Law 471/2002; Romanian Law 9/2008; Romanian Order 143/400).

Results. The values of the protein profile after six months of exposure to potassium dichromate in female rats are presented in Table 1 and Figure 1.

Table 1

Protein profile, seric values after six months of exposure to potassium dichromate

		Seric protein profile values				
		Total protein (g dL^{-1})	**Albumin (g dL^{-1})**	**Globulin (g dL^{-1})**	**Urea (mg dL^{-1})**	**Creatinine (mg dL^{-1})**
C	**(X±Sx)**	7.75±0.01	5.40±0.01	2.35±0.01	20.20±0.01	0.60±0.01
	S. D.	0.01	0.01	0.01	0.01	0.01
	C.L.	0.01	0.01	0.01	0.01	0.01
E_1	**(X±Sx)**	6.40±0.01	4.24±0.01	2.16±0.01	30.37±0.01	0.95±0.01
	S. D.	0.01	0.01	0.01	0.01	0.01
	C.L.	0.01	0.01	0.01	0.01	0.01
E_2	**(X±Sx)**	5.10±0.01	3.02±0.01	2.08±0.01	33.63±0.01	0.98±0.01
	S. D.	0.02	0.01	0.01	0.01	0.01
	C.L.	0.01	0.01	0.01	0.01	0.01
E_3	**(X±Sx)**	4.82±0.01	2.88±0.01	1.94±0.01	35.75±0.01	1.04±0.01
	S. D.	0.01	0.01	0.01	0.01	0.01
	C.L.	0.01	0.01	0.01	0.01	0.01

SD=standard deviation, CL=limits of confidence, X= mean,
Sx=the sample standard deviation of the variable "x".

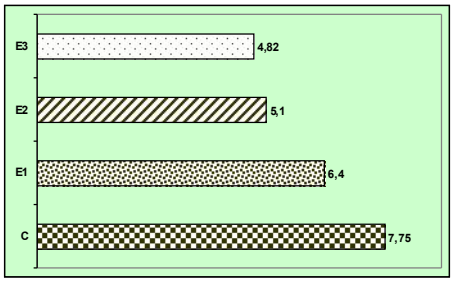

Figure 1. Total protein seric level

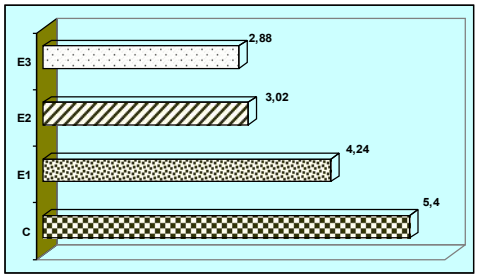

Figure 2. Albumin seric level

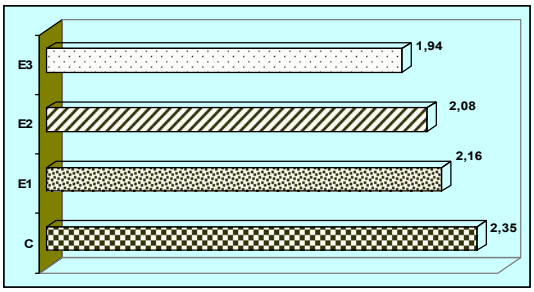

Figure 3. Globulin seric level

Total protein seric level decreased significantly ($p<0.01$) as compared to C group (E_1/C: -17.41%, E_2/C: -34.19%, E_3/C: -37.80%), below the bottom value of the physiologic limits (mean value: 7.2 g dL^{-1}, limits: 6.7 – 9.1 g dL^{-1}) (Giknis et al 2006).

The increase of the exposure level determined progressive, but significant ($p<0.01$) decrease of total protein seric level in experimental groups (E_2/E_1: -20.31%, E_3/E_2: -5.49%, E_3/E_1: -24.68%).

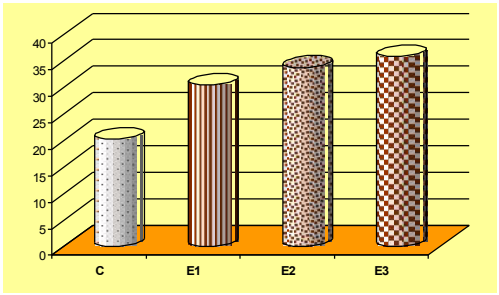

Figure 4. Urea seric level

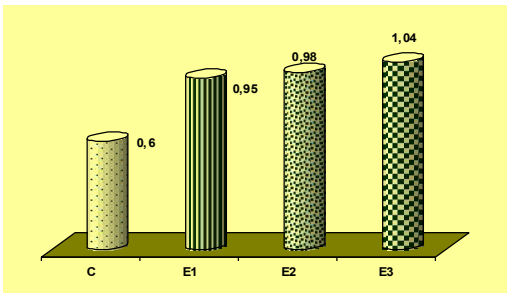

Figure 5. Creatinine seric level

The values of **albumin** were significantly ($p<0.01$) decreased in E groups as compared to C group (E_1/C: -21.48%, E_2/C: -44.07%, E_3/C: -46.66%), under the lowest physiologic limit (mean value: 5.35 g dL^{-1}, limits: 4.50-6.60 g dL^{-1}) (Giknis et al 2006). Albumin seric level was significantly and inversely ($p<0.01$) correlated with the exposure level (E_2/E_1: -28.77%, E_3/E_2: -4.63%, E_3/E_1: -32.07%).

Globulin seric level in E groups significantly ($p<0.01$) decreased in comparison to C group: E_1/C: -8.08%, E_2/C: -11.48%, E_3/C: -17.44%, inversely, significantly ($p<0.01$) correlated with the exposure level: E_2/E_1: -3.70%, E_3/E_2: -6.73%, E_3/E_1: -10.18%.

The seric level of **urea** significantly ($p<0.01$) increased in E groups as compared to the unexposed group (E_1/C: +50.34%, E_2/C: +66.48%, E_3/C: +76.98%) and exceeded the highest physiological value (mean value: 16.00 mg dL^{-1}, limits: 11.00-25.00 mg dL^{-1}) (Giknis et al 2006), in direct, significant ($p<0.01$) correlation, with the exposure (E_2/E_1: +10.73%, E_3/E_2: +6.30%, E_3/E_1: +17.71%).

Creatinine seric level increased significantly ($p<0.01$) as compared to C group (E_1/C: +58.33%, E_2/C: +63.33%, E_3/C: +73.33%), exceeding the highest physiological value (mean value: 0.83 mg dL^{-1}, limits: 0.5-0.9 mg dL^{-1}) (Giknis et al 2006), and directly, significantly ($p<0.01$) correlated with the exposure level (E_2/E_1: +3.15%, E_3/E_2: +6.12%, E_3/E_1: +9.47%).

Discussion. The results regarding the decrease of total protein level are in accord with those obtained by other authors (Chundawat & Sood 2004; Rao et al 2009).

The increased levels of creatinine and urea are due to the well known nephrotoxic effect of hexavalent chromium, also detected by other authors: Fatima & Mahmood (2007), Soudani et al (2010) – for ureea increase, and regarding creatinine: Lin et al (2009), Parveen et al (2009), Soudani et al (2010), Wu et al (2001).

Conclusions. A six months exposure of rats to potassium dichromate resulted in:

- a significant decrease of total protein seric concentration, inversely, and significantly correlated with the exposure level;
- a significant decrease of albumin and globulin levels, inversely, and significantly correlated with the exposure level;
- a significant increase of urea and creatinine levels, directly correlated with the exposure level.

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*** Romanian Law 206/27.05.2004 regarding work in scientific research, technological development and inovation
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