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Effect of potassium dichromate intake on feed intake and body weight, in female rats, *Rattus norvegicus* (exposure on three generations)

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Abstract. Material and methods: The experiments included three generations of female rats, each generation holding 28 White Wistar adult female rats, divided in 3 experimental (E) groups, exposed to 25ppmCr – LOAEL(E_1), 50 ppm Cr (E_2), 75 ppm Cr (E_3) and one control (C) group - tap water. Results: It pointed out significant decrease of daily feed mean consumption in the experimental groups comparative to C group, inversely, significantly correlated with the exposure level, in F_0, F_1 and F_2 generations, the mean daily feed intake decreasing with the increase of the number of generations exposed, the lowest being found in the case of F_2 generation, followed by F_1 generation and F_0, the differences being insignificant. Conclusion: The decrease of feed consumption, consecutive to hexavalent chromium intake, led to severe decreases in body weight.

Key Words: chromium, feed, females, rat.

Rezumat. Material şi metodă: Experimentele s-au desfăşurat pe trei generaţii de femele de şobolan, fiecare cuprinzând 28 de femele de şobolan adulte din rasa White Wistar, împărţite în trei grupuri experimentale (E), expuse la 25ppmCr – LOAEL(E_1), 50 ppm Cr (E_2), 75 ppm Cr (E_3) şi un grup martor (C) – apă de robinet. Rezultate: Experimentul a dezvăluit scăderea semnificativă a consumului mediu zilnic de furaj la loturile experimentale comparativ cu grupul martor, în corelaţie inversă, semnificativ, cu nivelul de expunere, la generaţiile F_0, F_1 şi F_2, media zilnică a aportului de furaj scăzând odată cu creşterea numărului de generaţii expuse, cea mai scăzută fiind întâlnită în cazul generaţiei F_2, urmată de F_1 şi F_0, cu diferenţe nesemnificative. Concluzie: Scăderea consumului de hrană, după ingestia cromului hexavalent, a dus la scăderi severe ale masei corporale.

Cuvinte cheie: crom, furaj, femele, şobolan.

Introduction. Exposure to hexavalent chromium is of concern in many chromium-related industries and their surrounding environments. Chromium VI compounds are widely used industrially, in stainless steel production, welding, electroplating, leather tanning, production of dyes and pigments and wood preservatives.

Industrial uses result in the annual release of more than 10^5 tons of chromium into the environment, and chromium contamination is of significant concern at many sites (Ott et al 2007; Myers et al 2009; Newairy et al 2009; Tabrez et al 2009), chromium exposure leading to severe health effects (Tabrez et al 2009).

Material and Method. Our study was carried out on three generations of White Wistar female rats, as follows: 28 adult female rats, exposed for three months to potassium dichromate, mated with males exposed also three months to potassium dichromate represented the F_0 generation.

The exposure of F_0 female rats continued during the pregnancy and lactation period. The F_1 generation females were exposed *in utero*, in suckling period, and after that via drinking water until sexual maturity. They were mated with other males exposed to the same doses of potassium dichromate.

The exposure followed during pregnancy and lactation, the resulting female offspring, belonging to F_2 generation being exposed until sexual maturity. So, the F_2 generation was exposed *in utero,* during suckling period and until sexual maturity.

In F_0, F_1 and the F_2 generation, feed consumption (in grams) was evaluated at sexual maturity in each case of exposure, after being calculated the daily intake, presented as a mean, by dividing the period to the number of days.

All generations were structured in one control group, C, that received tap water, not containing chromium, and three experimental groups: E_1: 25 ppm Cr VI – LOAEL for reproductive function (Toxicology Profile for Chromium, U.S. EPA, 2001), E_2: 50 ppm (2 X LOAEL), and E_3: 75 ppm (3 X LOAEL).

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

All assays in experiments, 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 daily mean feed intake in the case of three generations exposed to potassium dichromate are presented in table 1 and figure 1.

Feed consumption dynamics for the F_0, F_1 and F_2 generations was registered from the time when the pups started to consume by their own forages and water.

The mean feed daily intake was estimated from that moment and until the females reached the sexual maturity.

Table 1

Mean daily feed consumption in the case of three generation female rats exposed to potassium dichromate (25, 50 and 75 ppm CrVI)

		F_0 generation	*F_1 generation*	*F_2 generation*
C	(X±Sx)	35.52±0.01	36.42±0.01	35.89±0.01
	S. D.	0.01	0.01	0.01
	C.L.	0.01	0.01	0.01
E_1	(X±Sx)	30.82±0.01	30.42±0.01	28.48±0.01
	S. D.	0.01	0.01	0.01
	C.L.	0.01	0.01	0.01
E_2	(X±Sx)	31.01±0.01	28.53±0.01	24.33±0.01
	S. D.	0.01	0.01	0.01
	C.L.	0.01	0.01	0.01
E_3	(X±Sx)	30.02±0.01	27.33±0.01	20.19±0.01
	S. D.	0.01	0.01	0.01
	C.L.	0.01	0.01	0.01
X_E	(X±Sx)	30.62±0.3	28.76±0.9	24.33±2.39
	S. D.	0.53	1.56	4.15
	C.L.	3.64	3.64	3.64

SD=standard deviation, CL=limits of confidence, X= mean, Sx= the sample standard deviation of the variable "x", X_E = mean value for all experimental groups.

Generation F_0

Potassium dichromate exposure on several generations, pointed out, in F_0 generation's case, significant ($p<0.0001$) decrease of mean daily feed consumption in the case of experimental groups, comparative to control group (E_1/C: -13.23%, E_2/C: -12.69%, E_3/C: -15.48%), being inversely correlated, significantly, ($p<0.0001$), with the exposure level: E_3/E_2: -3.19%, E_3/E_1: -2.59%, excepting E_2 group (E_2/E_1: +0.61%).

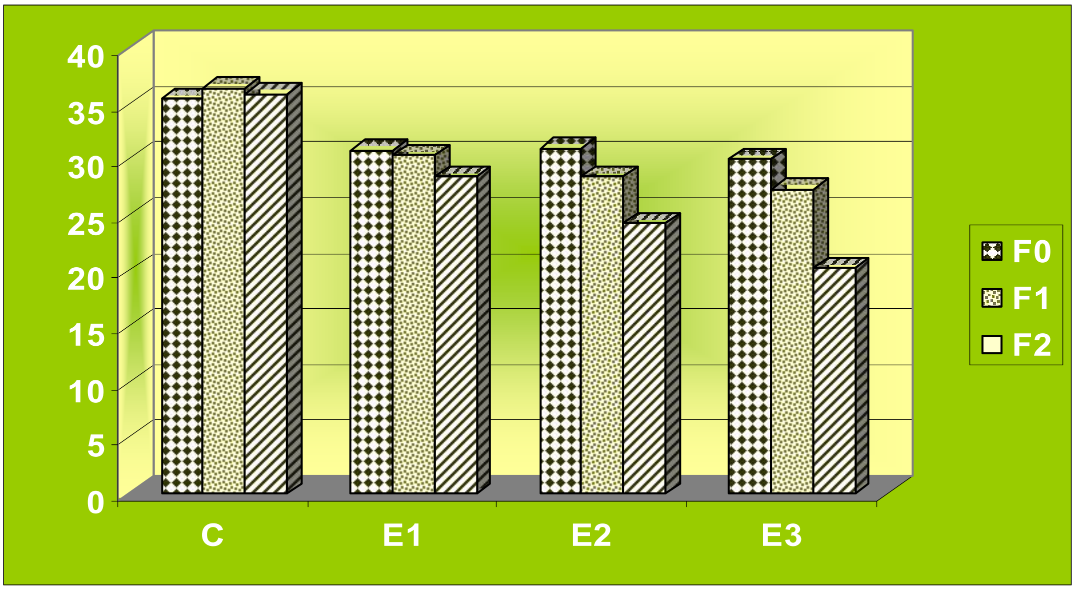

Figure 1. Main daily feed consumption in three generations exposed to potassium dichromate.

Generation F_1

In the case of F_1 generation, the mean daily feed consumption decreased significantly ($p<0.0001$) in the case of experimental groups, comparative to control group (E_1/C: -16.47%, E_2/C: -21.66%, E_3/C: -24.95%), inversely, significantly ($p<0.0001$) correlated with the exposure level: E_2/E_1: -6.21%, E_3/E_2: -4.20%, E_3/E_1: -10.15%.

F_2 Generation

The same situation was encountered in the case of F_2 generation feed consumption, when we registered significant decrease ($p<0.0001$) of mean daily feed consumption in experimental groups comparative to control group: (E_1/C: -20.64%, E_2/C: -32.20%, E_3/C: -43.74%), inversely, significantly ($p<0.0001$) correlated with the exposure level: E_2/E_1: -14.57%, E_3/E_2: -17.01%, E_3/E_1: -29.10% (see Figure 2).

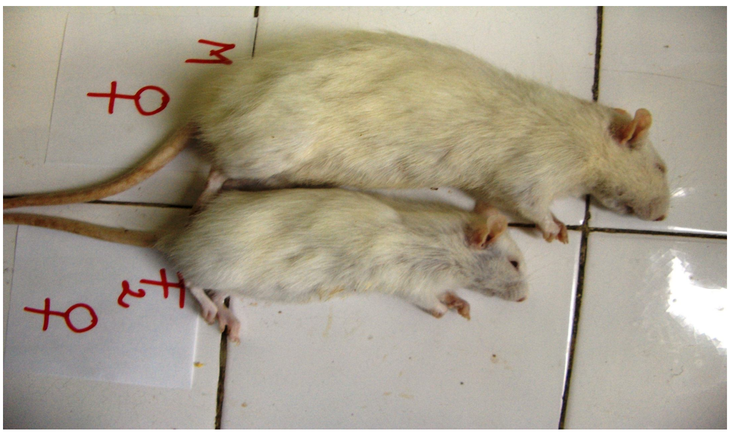

Figure 2. Weight difference in M (Romanian initial for control group) comparative to F_2 generation rat (asleep female rats).

The reduction of feed consumption lead to the decrease of body weight (and size) of the exposed rats, with important differences between control groups and experimental ones, and between generations, the biggest difference encountered between the F_2 generation and F_0.

Discussion. In the case of potassium dichromate exposure on several generations, the feed consumption decreased once with the increase of the number of generations, the lowest mean of feed consumption being found in the case of F_2 generation (X_E: 24.33 g), followed by F_1 (X_E: 28.76 g) and F_0 generation (X_E: 30.62 g), X_EF_1:/X_EF_0: -6.07%, X_EF_2:/X_EF_1: -15.40%, X_EF_2:/X_EF_0: -20.54%, the differences being insignificant (p>0.05).

The obtained results, regarding the decrease of feed consumption in the case of rats exposed to potassium dichromate, are in accord with those found by other authors: Oliveira et al 2010, Soudani et al 2010 and Mclachlan et al 2008, in other doses (125 and 250 ppm).

The decrease of body weight after potassium dichromate intake was also reported by De Lucca et al (2009), Staniek et al (2010), Rao et al (2009), Matos et al (2009).

Conclusions. A significant decrease of mean daily feed consumption was found in the case of F_0 generation compared to control group and an inversely, significantly correlated was described for intake, excepting E_2 group. A significant decrease of mean daily feed consumption was found as compared to control group and an inversely, significantly correlated was obtained for the exposure level in F_1 generation. A significant decrease of mean daily feed consumption was found in the case of F_2 generation when compared to control group and an inversely, significantly correlation was calculated for the chromium intake. The feed consumption decreased once with the increase of the number of generations, the lowest mean of feed consumption being found in the case of F_2 generation, followed by F_1 and F_0 generation, the differences being insignificant.

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*** Romanian Law 205/26.05.2004 regarding animal protection.
*** Romanian Law 206/27.05.2004 regarding work in scientific research, technological development and innovation.
*** Romanian Law 471/9.07.2002 for O.G. nr. 37/2002 approval for animal protection when used in scientific purposes and other experimental means.
*** Romanian Law 9/11.01.2008 for modification and addendum of 205/2004 Law regarding animal protection.
*** Romanian Order 143/400 for approval of instruction for housing and attendance of animals used in scientific purposes and other scientific means.
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