

THE EFFECT OF DEUTERIUM DEPLETED WATER ON SOME HEPATIC ENZYMES' ACTIVITY IN RATS INTOXICATED WITH CHROMIUM (VI)

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Abstract

The aim of these study was to show the effect of deuterium depleted water (DDW) (30 ppm deuterium) on the activity of some hepatic enzymes on rats intoxicated with chromium (VI). We used Wistar rats intoxicated with a single dose of $K_2Cr_2O_7$ 20 ppm Cr/body weight. Is known that the chromium (VI) affects especially the liver. The hepatocyte status is depicted by the alanin aminotransferase (ALT) and aspartat aminotransferase (AST) activities. The effect of chromium (VI) was maintained for 60 days for all groups. The 90th days treatment with DDW help the liver to recover.

Key words: Chromium- Deuterium depleted water- rat- hepatic enzymes

INTRODUCTION

The chromium is an essential oligoelement. The organism needs small quantities of chromium and this can be taken normally by food (bread, potatoes, fresh fruits and vegetables, liver, black pepper, etc.). The chromium has an important role in the glucose's metabolism, but the chromium salts are toxic for organism. The chromium toxicity depends on the oxidation stage and its solubility. Cr(VI) is more toxic than Cr(III) (Trivedi B., Saxena D.K., 1989). The chromium (VI) has toxic effects on liver and kidneys (Trivedi B., Saxena D.K., 1989, Sutherland, J. E. et al., 2000).

Deuterium depleted water (DDW) is water with a low deuterium content. If the tap water contains about 140-160 ppm deuterium, the DDW contain less than 80 ppm deuterium (in this study DDW contains 30 ppm deuterium). DDW is obtained at Drobeta Turnu Severin and Ramnicu Valcea, Romania.

There are many studies on deuterium depleted water, studies who prove that the DDW has a special influence on the cells and tissues development, has antioxidant properties, influence the whole organism (Hăulică I., et. al., 2002, Somlyai G., et. al., 1998, Somlyai G., 2001).

Deuterium depleted water has similar properties with the water from the inside of the cell of the living organism (Hăulică I., et. al., 2002).

MATERIAL AND METHOD

This experiment was carried on 96 Wistar female rats, adults, with a body weight of 200-260g, divided in 8 groups. The rats were maintained in good physiological conditions. The fodder received was a mixture of cereals (40% wheat, 40% corn, 20% sunflower), mixture which insures the nutritional and energetic value for the animals during the experiment, according to a corresponding diet.

L1	H ₂ O - 60 days		
L2	DDW (30 ppm) -60 days		
L3	H ₂ O - 30 days	K ₂ Cr ₂ O ₇	
L4	DDW (30 ppm) -30 days	K ₂ Cr ₂ O ₇	
L5	H ₂ O - 30 days	K ₂ Cr ₂ O ₇	H ₂ O - 30 days
L6	DDW (30 ppm) -30 days	K ₂ Cr ₂ O ₇	DDW (30 ppm) - 30 days
L7	H ₂ O - 30 days	K ₂ Cr ₂ O ₇	H ₂ O - 60 days
L8	DDW (30 ppm) -30 days	K ₂ Cr ₂ O ₇	DDW (30 ppm) - 60 days

A single doze of K₂Cr₂O₇ (20 ppm Cr(VI)/body weight) was administrated by gastric tubing in the 30th day.

24 hour after the chromium administration the blood were collected (on heparin), by cardiac punction from all groups. New samples were collected 30 respectively 60 days after the chromium intoxication from L₃, L₄, L₅, L₆ respectively L₇ and L₈.

The blood samples were collected under general narcosis (with chloroform) and the investigation were carried out with the approval of the Local Ethics Committee according the Romanian law 205/2004, art.7,18,22 and the regulation no.143/400/2002 and 37/2002, concerning with the protection of vertebrate animals used for experimental and other scientific purposes.

Alanin aminotransferase (ALT) and aspartat aminotransferase (AST) were determined in plasma by colorimetric methods (Ghergariu S. et al., 2000). DDW was obtained in accordance with a contract between the Faculty of Veterinary Medicine of Timisoara and the heavy water plant ROMAG, Drobeta-Turnu-Severin, Romania. The data are presented as means $\pm$ S.D. values. ANOVA, TTest, MINITAB and nonparametric test Mann-Whitney were used to analyse mean difference between experimental groups and for each parameter separately and between the groups.

RESULTS AND DISSCUSIONS

After 30 days from the beginning of the experiment the ALT's activity was maintained in normal limits for the L₂ groups, treated with DDW (30 ppm).

At L₃, 24 hour after chromium intoxication the ALT's activity significant decreased ($p < 0.001$) compared to the control (L₁) and also to the L₂ (treated with DDW) (83.7%). This value indicate an important affectation of the liver according to the scientific data (Kim H.Y. et al., 2004).

At L₄ group, after 30 days of pre-treatment with DDW, the chromium intoxication after 24 hour made the ALT's activity to decrease insignificant, to the 21.11 ± 5.82 UI, a little lower then the physiological values. The affectation of the liver is insignificant at the DDW pre-treated groups.

90 days treatment with DDW improved the ALT's activity value (45.12 ± 7.88 UI) ($p < 0.05$). This value is in physiological limits according the scientific paper (Ghergariu S. et al., 2000, Meingassner J.K., Schmook F.P., 1992). The results are presented in table 1 and figure 1.

The AST's activity recorded significant lower values ($p < 0.001$) (8.508 ± 0.28 U/l) at L₃ groups (intoxicated with chromium and untreated, 24 hour after intoxication) compare to the control.

In the pre-treated group (L₄) the AST'activity was significant higher even of the control (26.448 ± 21.923 U/l) ($p < 0.001$).

After 60 days of treatment with DDW the AST's activity values showed that the chromium intoxication affected the liver yet. After 90 days of treatement with DDW the values of AST activity were similar with those of the scientific paper (Ghergariu S. et al., 2000, Meingassner J.K., Schmook F.P., 1992), significant increased ($p < 0.001$). The results are presented in table 1 and figure 2.

Table 1.

The mean values of alanin aminotransferase and aspartat aminotransferase in rats intoxicated with chromium (VI) in single dose and treated with DDW

	ALT (U/l)	AST (U/l)
L1 (H ₂ O)	23.885± 1.202	18.08± 1.571
L2 (DDW 30)	30.69± 5.917***	16.811± 1.149**
L3 (H ₂ O +Cr)	4.988± 0.159***	8.508± 0.281***
L4 (DDW +Cr)	21.106± 5.825	26.448± 21.923***
L5 (H ₂ O+Cr+H ₂ O)	44.36± 0.377**	11.20± 2.420***
L6 (DDW +Cr+DDW)	26.656± 2.498	14.42± 7.799
L7 (H ₂ O+Cr+H ₂ O60)	50.455± 13.827**	89.23± 4.827***
L8 (DDW+Cr+DDW60)	45.117± 7.880**	81.955± 8.039***

Mean ± S.D.; n= 12 animals/group, * p> 0,05, ** p< 0,05, *** p< 0,001

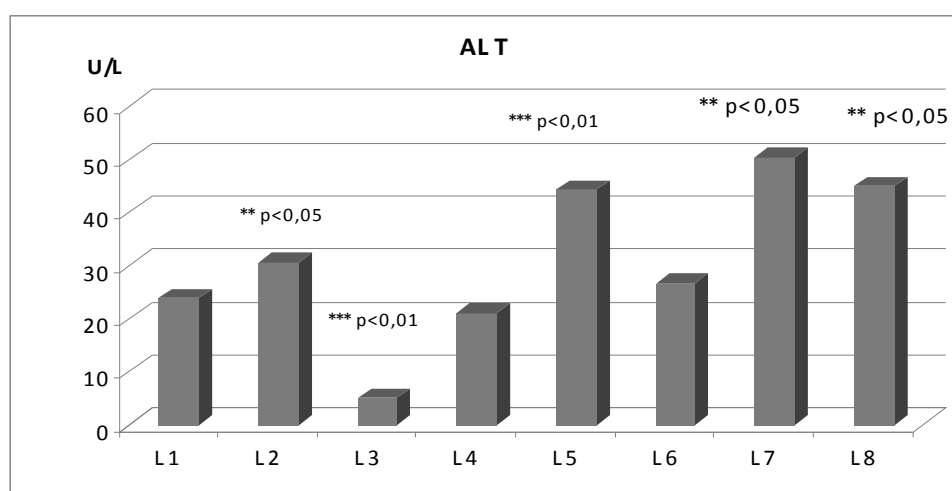


Figure 1. The mean values of ALT's activity in rats intoxicated with chromium in single dose and treated with DDW

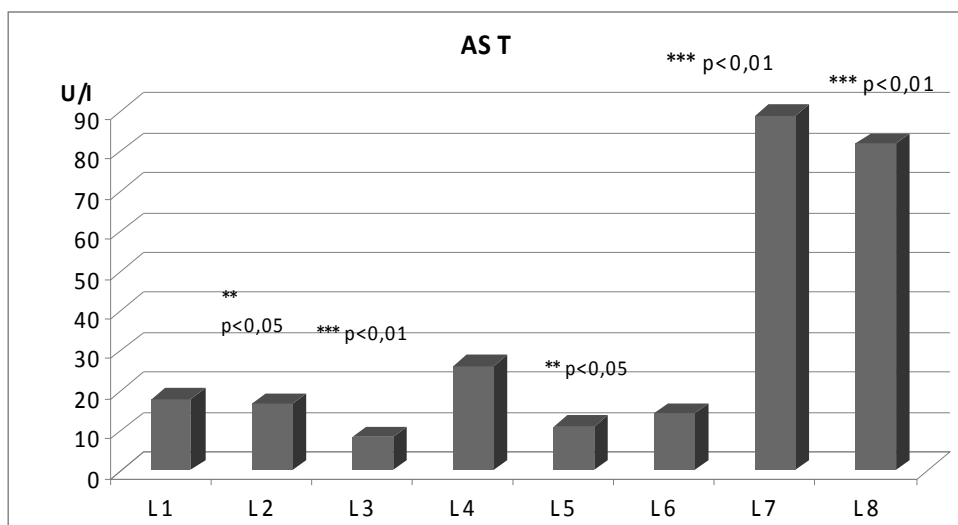


Figure 2. The mean values of AST's activity in rats intoxicated with chromium in single dose and treated with DDW

CONCLUSIONS

The chromium maintained its toxic effects even after 60 days from the intoxication.

After 90 days of treatment with DDW (30 ppm) the ALT and AST's activity reached similar level to those recorded in the scientific paper.

The DDW pre-treatment (30 days) protects the liver from the chromium toxicity and have an important scavenger role.

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REFERENCES

1. Ghergariu S., Pop A., Kadar L., 2000, Marina Spînu, Manual de laborator clinic veterinar, Ed. All Educational, Bucureşti
2. Hăulică, I., Ştefănescu, I., Bild, W., Tişescu, Gh., Tamian, R., Năstasă, V., Ioniţa, Th., 2002, Cercetari asupra efectelor fiziologice ale apei saracita în deuteriu asupra imunitatii nespecifice, Conferinta INGIMED, ed. III-a, Bucuresti.
3. Kim H.Y., Lee S.B., Yang B.S., 2004, Subchronic inhalation of soluble hexavalent chromium trioxide in rats, Arch.Toxicol., 78(7), 363-368.
4. Meingassner J.K., Schmook F.P., 1992, Reference values for rats, Charles River Ed., Vienna.
5. Somlyai G., Jacson, G., Jakli, T., Berkenyi, Gy., Lascay, Z., 1998, Progress of cryogenic and isotops separation, Calimanesti
6. Somlyai G., 2001, The biological effects of Deuterium Depletion, HYD Ltd., ISBN o-7596-9261-0
7. Sutherland, J. E., Zhitkovich, A., Kluz, T., 2000, Chromium intoxication in rats, Biol. Trace Elem. Res., 41-53
8. Trivedi B., Saxena D.K., 1989, Embriotoxicity and fetotoxicity of orally admistered hexavalent chromium in mice, Reprod. Toxicol., 275-278; <http://rais.ornl.gov/tox/profiles/chromium.shtml>