Trav. Mus. Hist. nat. «Grigore Antipa»	Vol. XXII	pp. 81 – 84	București, 1980

BIOCHEMICAL CHANGES IN THE LIVER AFTER IRRADIATION AND UNDER THE INFLUENCE OF NON-TOXIC RADIOPROTECTORS

MARIA BORȘA, ȘTEFANIA MANCIULEA, ZOLTAN URAY, ALEXANDRU D. ABRAHAM

The treatment of rats with Madiol and Leucotrophin-R after their irradiation with X-rays (400 R) induced a recovery of glycaemia and of the liver glycogen content. No changes in protein and lipid synthesis were observed.

Liver is especially affected after the administration of toxic chemical radioprotectors and some injuries caused by radiation energy are more accentuated **(1, 2)**. Therefore, considerable emphasis must be laid on the development of less toxic new agents possessing lasting protective action.

Wistar rats were irradiated with sub-lethal dose of X-rays and treated with an anabolizing steroid (Madiol) and a lymphostimulatory factor (Leucotraphine-R).

MATERIAL AND METHODS

Male Wistar rats (130—160 g) were kept in standard food and at room temperature. I. group of animals were irradiated with 400 R and killed at 3 (I_3), 8 (I_8) and 15 (I_{15}) days after irradiation. II. group of animals were treated a.r. with a total dose of 30 mg Madiol (Biofarm, Bucharest) per 100 g body weight, *per os* during a period of 30 days. After this the rats were irradiated with 400 R p.r. injected with 1 ml Leucotrophine-R (ELLEM-SPA, Milano) until 3 (II_3), 8 (II_8) and 15 (II_{15}) days. Serum glucose level **(6)**, liver glycogen content **(5)** and protein concentration of liver **(4)** were determined. 1 hour before killing some rats received 2 μCi of (2—^{14}C) acetate of Sodium and the rate of incorporation of ^{14}C into proteins and lipids was determined. The specific radioactivity was measured by dissolving of proteins in Bray's solution and of lipids in T-fluor, using a liquid scintillation Spectrometer

(BF-5003). The results were evaluated by Chauvenet's and Student's statistical methods.

RESULTS AND DISCUSSION

The results obtained showed an increase of serum glucose level by the irradiated rats (Fig. 1a), comparing with the non-irradiated controls. Concomitently, a sharp enhance of liver glycogen content after irradiation was observed, especially in the I_3 and I_{15} groups (Fig., 1b) These effects of high doses of X-irradiation were observed by other authors too **(7)**, as a consequence of stress effect of whole-body irradiation **(1, 2)**. Administration of Madiol and Leucotrophine-R determined less increase of the glycaemia and liver glycogen content in comparison with the irradiated groups after 3 days (I_3). As it can be seen from fig. 1a and 1b, at the 8th day no significant differences were observed between the treated and irradiated non-treated groups. After a prolonged treatment with Leucotrophine-R, the radioprotective effect of these substances revealed the restoration of the level of serum glucose. The glycogen concentration in the liver of irradiated animals is increased against controls, a four fold increase being observed, especially the 15th day after exposure. Treatment with Madiol and Leucotrophine-R determined considerable decrease of glycogen content in the liver against irradiated group, but the values remained enhanced against the controls ones. These data suggest an excellent radioprotective effect of these substances, which is manifested by the prevention of biochemical damages provoked by X-rays.

The protein concentration in the liver of irradiated rats decresed lineary to the time elapsed after exposure, treatment with Madiol and Leucotrophine-R determining after 3 days the return of the protein concentration toward the control values (Fig. 1c). The rate of incorporation of ^{14}C from acetate into proteins, in general, was higher in the irradiated groups, as well as, in the treated groups against controls (Tab. 1). Earlier investigations demonstrated also an enhanced liver protein synthesis in rats after whole-body irradiation **(3, 8)**.

The rate of biosynthesis of liver lipids is increased especially the 8th day after exposure. In the treated group (II°) six-fold increase of liver lipid biosynthesis was observed, which can be explained by the higher capacity of liver to use acetate in relatively radioresistant biosynthetic pathways under the influence of radiation energy and biostimulators (Tab. 2).

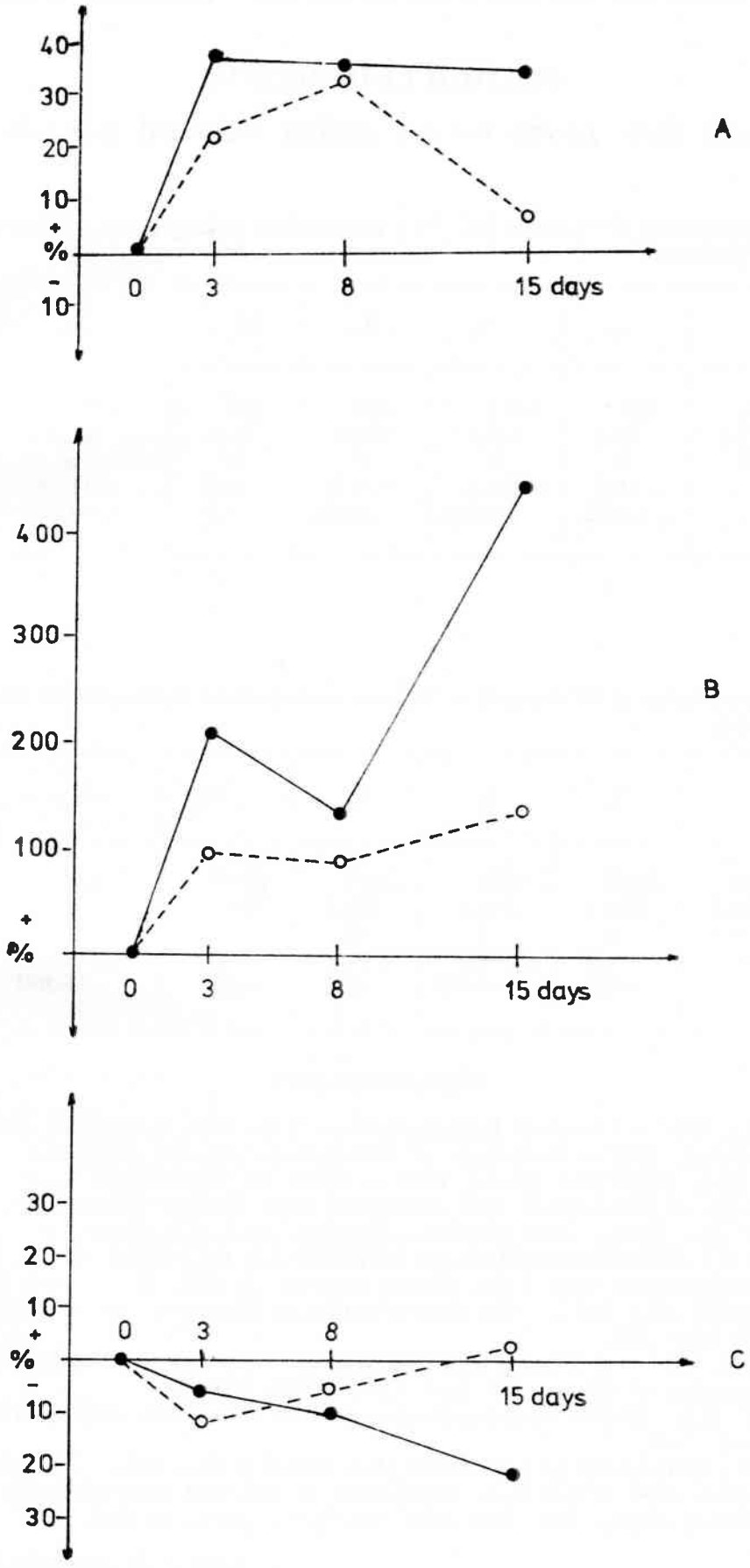

Fig. 1 — Per cent changes of serum glucose level (a), liver glycogen content (b) and protein concentration (c) of irradiated rats (.——.) and irradiated and treated rats (.——.) against control non-irradiated rats.

ACKNOWLEDGMENTS

We thank Ilyés István for his skilfull technical assistance.

TABLE 1

The rate of incorporation of ^{14}C from (2 — ^{14}C) acetate into liver proteins (DPM/1 hour and 100 mg of isolated proteins).

Control		I_3	I_8	I_{15}	II_3	II_8	II_{15}
X	304	431	1314	835	355	1575	765
± S.E.	17,4	39,4	155,1	62,7	16,5	61,8	55,2
n	8	8	6	7	8	6	8
%	—	+ 41,7	+331,8	+174,5	+ 16,8	+417,6	+ 151,4
p	—	<0,02	<0,001	<0,001	<0,05	<0,001	<0,001

TABLE 2

The rate of incorporation of ^{14}C from (2 — ^{14}C) acetate into liver lipids (DPM/1 hour and 100 mg of isolated lipids).

Control		I_3	I_8	I_{15}	II_3	II_8	II_{15}
X	2110	2007	4859	2633	2142	15454	2078
± S.E.	128,5	228,6	244,6	491,7	168,4	2550,8	206,8
n	8	8	6	8	8	8	8
%	—	−4,9	+130,3	+24,8	+1,54	+632,6	−2,50
p	—	>0,5	<0,001	>0,5	>0,5	<0,001	>0,5

BIBLIOGRAPHY

1. BACQ (Z.M.), 1965 — Chemical Radioprotection: 138—142, *Springfield, Illinois.*
2. BERDJIS (C.C.), 1971 — Pathology of Irradiation: 58—62, *Baltimore.*
3. FERENCZ (A.), HIDVEGI (E.J.), 1976 — Effect of Whole-Body Irradiation the Synthesis of Ribonucleic Acid Associated with Nuclear Ribonucleoprotein Particles of Rat Liver. *Acta Biochim., Biophys. Acad. Sci. Hung.*, **11**, *1*: 11—22.
4. LOWRY (O.H.), ROSEBROUCH (N.J.), FARR (A.L.), RANDALL (R.Y.), 1951 — Protein measuremant with Folin phenol reagent. *J. biol. Chem.*, **193**: 265—274.
5. MONTGOMERY (R.), 1957 — The determination of Glycogen. *Archs Biochem. Biophys.*, **67**: 378—385.
6. NELSON (N.), 1944 — A Photometric Adaptation of the Somogyi method for the Determination of Glucose. *J. biol. Chem.*, **153**: 375—380.
7. STREFFER (C.), 1969 — Strahlen-Biochemie: 96—100; 128—130, *Berlin, Heidelberg-New York.*
8. SZABO (L.D.), HOLLAND (J.), KÖRÖSI (E.), BÖLÖNI (E.), 1976 — Comparative Investigation after Whole-Body Irradiation of different dose-intensities. *12th Annual Meeting Europ. Soc. Rad. Biol. Budapest.* Abstr., **2**: 140.

Centrul de Cercetări Biologice
Str. Republicii, 48
3400 Cluj-Napoca. România