

## THE BIOLOGICAL EFFECTS OF LOW DOSES OF IONIZING RADIATION ON ADAPTIVE POSSIBILITIES OF THE ORGANISM

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### Abstract

The study of adaptive possibilities and cancer risk in animals exposed at low doses of ionizing radiation was the object of the present work. The action of immunostimulating treatment on these processes was studied as well.

In previously irradiated animals the diminution of adaptive possibilities and of the antitumoral resistance of the organism was observed. The stimulating action of Bufostimulin on these processes in irradiated animals was less pronounced than in unirradiated ones.

The evaluation of the adaptive possibilities and cancer risk in persons at low doses of ionizing radiation remains an important problem of scientific investigations [1, 2]. The study of the adaptive possibilities of enterocytes and antitumoral resistance of the organism in animals exposed at low doses of ionizing radiation was the object of the present work. The action of Bufostimulin (BS) application on these processes was studied as well.

### Materials and methods

70 white inbred female rats weighing 160-170 gm and 200 white inbred female mice weighing 22-23 gm were taken in experiment. In rats beforehand exposed at 25R whole-body x-irradiation the adaptive possibilities of enterocytes were tested. The following groups of animals were distinguished: 1) control-10; 2) unirradiated + carbo-hydrates diet - 10; 3-4) irradiated - 20 (by 10 within 30 and 60 days after irradiation accordingly); 5-6) irradiated + diet - 20; 7-8) irradiated + BS + diet - 20. The carbo-hydrates diet consisted of substitution of drinking - water by 5% solution of sugar and addition of sugar beet in ratio (by 10 gm of beet daily for each animal). The administration of diet lasted for 7 days before the experiment.

In mice irradiated at the same conditions the appearance of skin cancer after application of DMBA (Flaka AC, Bucha SG) was studied. DMBA was applied twice weekly during 3,5 months, beginning 2 weeks after irradiation. The following groups were followed: 1) control - 50; 2) unirradiated + BS -50; 3) irradiated - 50; 4) irradiated + BS - 50.

BS is an immunostimulant which is obtained from the secretion of suprascapular glands of *Bufo viridis* L.

### Results

The received data demonstrate after the administration of carbo-hydrates diet the membrane digestion is modified considerably (table I). The invertase activity on the intestinal micoso (membrane digestion of sucrose) and the tissular homogenates (the common content of this enzyme into enterocytes) in experimental animals (group 2) was increased by 36.6% ( $p < 0.001$ ) and 90.1% ( $p < 0.002$ ) accordingly. In irradiated rats the adaptive possibilities of enterocytes were altered both after 30 and 60 days. In 5<sup>th</sup> group in comparison with 3<sup>rd</sup> group the indices of invertase activity were not different, in the 6<sup>th</sup> group the modifications of enzymatic activity in comparison with the 4<sup>th</sup> group were less pronounced. BS in animals irradiated by 1 month before the experiment was ineffective, in irradiated by 2 months before the experiment the application of BS results in the enhancement of invertase activity only on the mucosal surface.

Table 1. The modifications of adaptive possibilities of enterocytes after whole-body X- irradiation at dose 25 R.

Test	Control	Unirradiated + diet	Days after irradiation					
			30			60		
			Irradiated	Irradiated + diet	Irradiated + diet + BS	Irradiated	Irradiated + diet	Irradiated + diet + BS
Invertase activity on intestinal mucosa	40.7 ± 1.9	55.6* ± 2.1	43.3 ± 2.7	41.4 ± 1.7	42.8 ± 2.7	41.6 ± 1.1	46.7* ± 1.5	53.5* ± 2.7
Invertase activity in the tissular homogenates	92.8 ± 5.0	176.4* ± 24.4	87.5 ± 3.5	95.4 ± 6.2	95.6 ± 7.6	85.7 ± 4.0	120.7* ± 7.8	140.9 ± 9.9

\*  $p < 0.05$

The appearance of benign tumors in all groups of animals was likewise (table 2). The first papillomas appeared in a month after beginning of DMBA application. During all period of the experiment the papillomas appeared in 43 mice of I group, 44 - II group, 42 - III group

Table 2. The action of BS on benignant tumors appearance in unirradiated and irradiated mice after application of DMBA

Group	Weeks after beginning of DMBA applications					
	4	6	8	10	12	13
Control	12	12	29	36	39	44
Unirradiated + BS	8	14	20	30	37	43
Irradiated	8	14	32	37	39	43
Irradiated + BS	11	15	24	33	38	42

Table 3. The action of BS on malignant tumors appearance in unirradiated and irradiated mice after application of DMBA

Group	Weeks after beginning of DMBA applications							
	10	13	15	17	20	22	24	26
Control	3	4	8	11	18	35	35	35
Unirradiated + BS	-	-	4	6	12	22	23	26
Irradiated	4	7	11	21	28	31	34	35
Irradiated + BS	2	3	8	14	26	30	36	36

and 43 - IV group. The dynamics of malignant tumors appearance in mentioned groups of animals was different. In irradiated mice the appearance of skin cancer was established in 9 weeks after beginning of DMBA applications, in unirradiated mice in 10 weeks.(table 3)

Further on in irradiated mice the number of animals with skin cancer was greater than in unirradiated ones. The administration of BS in unirradiated mice was more efficient than in irradiated ones. Thus 18 weeks after beginning the DMBA application in I group were 14 cancer, in II - 8, in III - 28 and in IV - 16. Further on this difference remains. But at the end of the experiment the skin cancers appeared in all survived animals.

#### **Discussion**

The adaptive possibilities of the organism after low doses of ionizing irradiation are disturbed. This is confirmed by the diminution of adaptive possibilities of enterocytes to functional tests (loading) of the digestive tract with easy assimilated carbo-hydrates and by speeding up of malignant tumors appearance after carcinogens application. About cancer risk increase in persons irradiated at low doses of ionizing irradiation has related J.Gofman [3].

The immunomodulating treatment with BS in previously irradiated animals at low doses is less pronounced. In unirradiated mice the administration of BS resulted in a considerable increase of antitumoral resistance of the organism which was expressed in a latest appearance of malignant tumors. In irradiated ones this action of BS was less. The stimulating action of BS on adaptive possibilities of enterocytes after application of diet containing easy assimilated carbo-hydrates was diminished as well.

#### *References*

[1] Howe,G.R., Lung cancer mortality between 1950 and 1987 after exposure to fractionated moderate-dose-rate ionizing radiation in the Canadian fluoroscopy cohort study and a comparison with lung cancer mortality in the Atomic Bomb survivors study, *Radiation Res.*, 140 3 (1995) 295-304.

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