Mechanisms of Action of EM Preparations in the Organism

E. F. Konoplya[a)], Teruo Higa[b)]
[a)]*Institute of Radiobiology of the National Academy of Sciences of Belarus, Minsk, Belarus*
[b)]*College of Agriculture, University of the Ryukyus, Japan*

Introduction

The present paper deals with the study of EM-X properties carried out by the Institute of Radiobiology of National Academy of Sciences of Belarus during the last several years.

The philosophy of study of the mechanisms of EM-X action in the organism – taking into account the existing prerequisites – supposed, firstly, the assessment of antioxidant and immunocorrecting properties of EM-X, and EM-X effects on endocrine system, cellular composition of blood, nucleic-protein metabolism and to other processes in organism, and secondly – in order to assess the EM-X effect on any physiologic system or exchange processes, the most demonstrative and efficient would be the study of organism's systems altered due to the influence of some injuring factor. The ionizing radiation was adopted as such a factor.

In the presence of such a powerful injuring factor, however, it is very important to choose the right means to protect organisms from radiation and normalize the peroxidation and immune systems once affected. It is also very important in the search for radioprotective properties that they are as physiologically acceptable and admissible for as long as an administration as possible. These two conditions are essential in resolving the problems stemming from nuclear accident, where the population must live on radiocontaminated lands and undergoes chronic exposure for decades.

Such situation is present in Belarus where 21% of the territory with about 2.0 million residents – adults and children – is polluted with Cs-137, Sr-90, Pu-239, 240, 241, Am-241, 1-141 and other isotopes.

Objectives

The objective was to study the effect of EM-1 and EM-X preparation on the state of important systems of living organisms: immune, endocrine, lipid peroxidation and antioxidant system, as well as on a number of exchange processes – protein, nucleic etc.

Method

In order to reveal the mechanisms of EM-1 and EM-X effect, were used modern methods of spectrometry and radiochemical analysis for determining biologically active substances in the organism and functions of separate physiological systems.

Results

The main attention was paid to the study of antioxidant and immunocorrecting action of EM-X, reducing the biomedical consequences of irradiation, on the models of organism's exposure to ionizing radiation.

Prior to the study, we had little information, for example – what is the effective EM-X dosage and what is the scheme of its administration. Eventually the experiment had to be preceded by a series tests to determine the optimum dose levels of EM-X for lethal and low doses of irradiation as well as acute and chronic ones. EM-X was applied also to the experimental animals within the 30-km zone from the Chernobyl accident 1986 from where the population had to be evacuated in.

The first set of experiments was related to the lethal doses of irradiation. However we had no significant success with the high level of injuring factor. Therefore, we dealt with low irradiation doses and chronic irradiation.

It is known that the irradiation of organism leads to the activation of peroxidation systems with the formation of hydroperoxides and the decline of functions in the antioxidant system. Particular (Fig.1), the chronic ?-irradiation of animals in 1.0 Gy dose was accompanied by the accumulation of malonic dialdehide in the blood. This is one of the basic products of lipid peroxidation. Simultaneously, the decline of blood antioxidant activity was observed. The EM-X application after the irradiation (20 ml/100 gof weight per 10 dyas) prevented the accumulation of malonic dialdehide in blood and the decline of blood antioxidant activity. The 2-times and higher increase of EM-X dosage did not cause the increase of effect; this testing the importance of choice of optimum EM-X dosage.

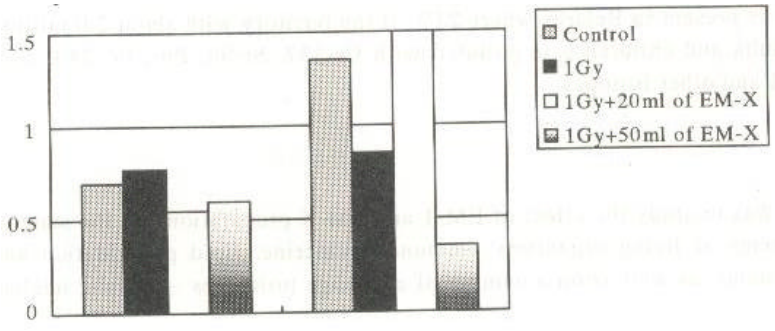

Fig. 1 Effect of EM-X on lipid peroxidation system

MDA – malonic dialdehide
AOA – activity of antioxidation system
The activity in the blood erythrocytes of superoxide dismutase, one of principal enzymes for antioxidant protection, declines after the chronic irradiation. The EM-X application during the irradiation normalized the level of superoxide dismutase activity. The effect was higher when the EM-X dose was higher. (Fig. 2)

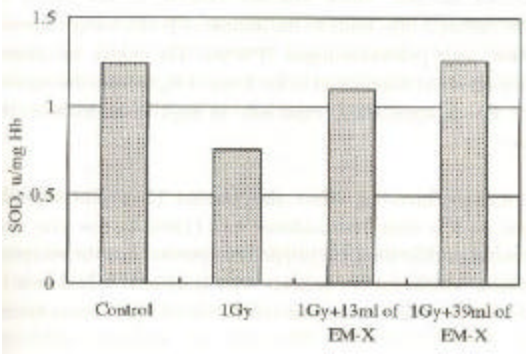

Figure Effect of EM-X on superoxide dismutase activity in blood erythrocytes under the irradiation

The same results were obtained for the EM-X application in the area of the 30-km evacuation zone where the animals underwent the chronic exposure. Namely, at the organism irradiation the increase of hydroperoxides was observed on the one hand, and on the other hand the antioxidant protection declined. The application of EM-X exerted the normalizing effect on these processes.

Concerning another antioxidant enzyme –catalase: the changes analogous to those of superoxide dismutase were observed, though less expressed.

Thereby it is summarized that the EM-X has an antioxidant influence leading to the decline of hydroperoxides formation and activating the fermentative link of the antioxidant system.

The second important direction of the study of the mechanism of EM-X action was the investigation of its effect on the immune system.

At first, it was assessed that the EM-X effect on the mass of the thymus and the spleen, the basic organs of immunogenesis, was found, irrespective of the dosage, to lower the injuring effects of radiation and decrease the amounts of radiation in the spleen and thymus.

The study of blood cellular composition is a simple method for assessing EM-X effect in the organism. As a result of this study, an important fact was established:

the EM-X application promotes the normalization of lymphocytes content under the action of the injuring factor. This normalization improves the immune protection of the organism.

In order to study further the mechanisms of the EM-X effect on the immune system, the activation, proliferation and reception abilities of T- and B-lymphocytes were investigated.

The chronic exposure of animals in 1.0 Gy dose leads to the activationnnn of spontaneous proliferation of lymphocytes. The decline of activation of T-cellular receptor concanavalin A (Con-A) was obsereved in irradiated animals which did not recover at the action of formil-miristate acetate (FMA). The radiation also leads to the decline of proliferation response of B-lymphocytes to the activation with pokwid-mitogen (PWM). The above mentioned irradiation dose causes the desensitizing effect manifested in the form of significant decrease of interleukin-2 (Il-2) reception. The EM-X application, especially in high dose, leads to the restoration of immunologic indices.

It is important to stress that the immunocorrecting effect also persists 12 months after exposure and EM-X administration. As it is seen fom adduced data (Table 1), one year after the exposure the increased spontaneous proliferation of lymphocytes persists and the reception properties of T-lymphocytes declined, which did not recover with additional stimulation by FMA. In animals, which received EM-X in higher dose, the restoration of the immune system was observed.

Table 1 Effect of EM-X on the proliferation ability of T-lymphocytes

#	Groups	Spontaneous proliferation, CPN	Concanvalin, units	Concanvalin + formil-miristat, units
1	Control	1119.0	11.3	12.1
2	Irradiation	2174.0	4.7	6.5
3	EM-X 1.0ml x 3 times	836.0	7.5	7.5
4	EM-X 3.0ml x 3 times	1324.0	9.9	9.9

(12 months later)

The reception and proliferation function B—lymphocytes (Table 2) turned out less variation among the treatment groups than T-lymphocytes. The greatest variation 12 months after the irradiation is found for the stimulation of blasts with lipopolysaccharides:

Table 2 Effect of EM-X on the proliferation ability of B-lymphocytes

#	Groups	Spontaneous proliferation, CPN	Concanvalin, units	Concanvalin + formil-miristat, units
1	Control	7.54	10.6	10.4
2	Irradiation	6.85	10.5	6.5
3	EM-X 1.0ml x 3 times	7.35	9.45	8.0
4	EM-X 3.0ml x 3 times	6.15	10.6	9.4

(12 months later)

Thus the EM-X application conditions the immunocorrecting actions under the irradiation of organism.

The endocrine system of an organism is quite sensitive and important. This system is vulnerable to radiation. In this connection, the possibility of EM-X application for decreasing the injury to sex glands, adrenal glands, thyroid and the mechanisms of hormonal of hormonal activity in tissues was studies.

Chronic irradiation for several months led to the decline of testosterone formation and in mass of testes, and, to a lesser degree, it affected the estrous cycle and the mass of the ovaries. Also changed were the association constant and the number of places of steroid binding in tissues. The EM-X application in that case reduced the suppression of testosterone formation and the decrease of testes mass. In lesser degree such effects were registered concerning the level of estrogen in blood and the mass of ovaries.

Conclusion

The following were concluded from the results of EM-X application:
Firstly, EM-X exerts the antioxidant and imunocorrecting effects and can improve the function of endocrine glands.

Secondly, because of the above functions, the EM-X application is to be recommended first not only for radiation injury, especially through chronic irradiation, but also for other injuring factors, when the functions of immune and antioxidant systems are disturbed.