THE EFFECT OF SELENIUM AND GREEN ALGA MOMOTARU E-25 ON RADIATION CARCINOGENESIS AND LEUKAEMIA IN RATS EXPOSED TO IONIZING RADIATION

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INTRODUCTION

During the past decades several studies of radioprotective agents indicated that the antioxidative properties of selenium provide protection against free radical damage resulting from peroxidative conditions or ionizing radiation.

SELENIUM EXPERIMENT

In a long-term study four groups of 80 white mongrel rats each were exposed to radiation following the Chernobyl pattern. A control group of 80 animals was not irradiated. The fodder for three of the irradiated groups was supplemented with selenium containing yeast (1) to ensure a selenium content of 0.5 mg/kg, 1.5 mg/kg and 5 mg/kg, respectively.

During the 2.5-year study, the total cancer incidence was 7 (8.75%) cases in the control group. There were 53 (66.25%) cancer cases in the irradiated but not treated group, whereas there were 21 (26.25%), 16 (20.0%) and 19 (23.75%) cancer cases, respectively, in the selenium supplemented groups (Figure 1).

Over the same period there were 2 (2.5%) cases of leukaemia in the control group. In the irradiated but not supplemented group leukaemias totaled 13 (16.25%), while in the supplemented groups there were 4 (5.0%), 1 (1.25%) and 5 (6.25%) cases, respectively (Figure 2).

Radiation is mediated through formation of free radicals. When tissues are exposed to high energy radiation, most of the energy is absorbed by cell water. Radiation causes one of the oxygen-hydrogen covalent bonds in water to split, creating hydrogen and hydroxyl radicals. The hydrogen radical is the most reactive one known in chemistry, it can readily cause DNA damage. The selenium depending enzyme, glutathione peroxidaze, is supposed to be the endogenous scavenger of the hydroxyl radical (2).

Recently, an anticarcinogenic activity of beta-carotene and some other biological agents of vegetable origin has been reported. This effect is, however, unlikely to be associated directly with antioxidants. Besides, there is no evidence of any superiority of these substances to selenium as means of cancer prophylaxis.

In the study to follow we wished to investigate possible effects (synergism, antagonism) of selenium and Green alga Momotaru E-25, a biologically active strain obtained in Japan, when used in combination.

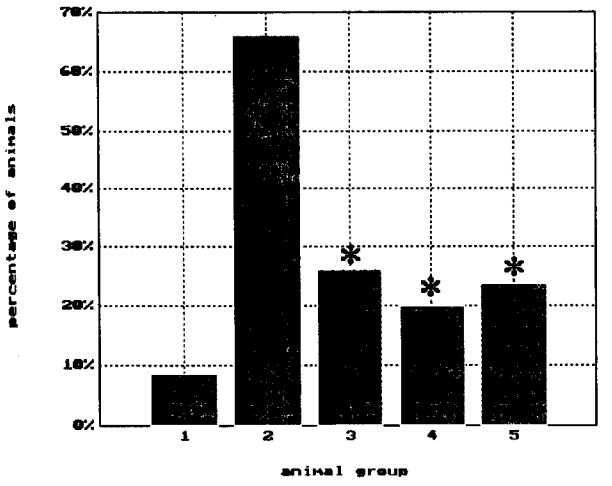

Figure 1. Total cancer incidence (pituitary, thyroid, breast, lung, ovary, uterus, kidney, liver plus leukaemia).
* $P < 0.05$ for comparison with group 2.

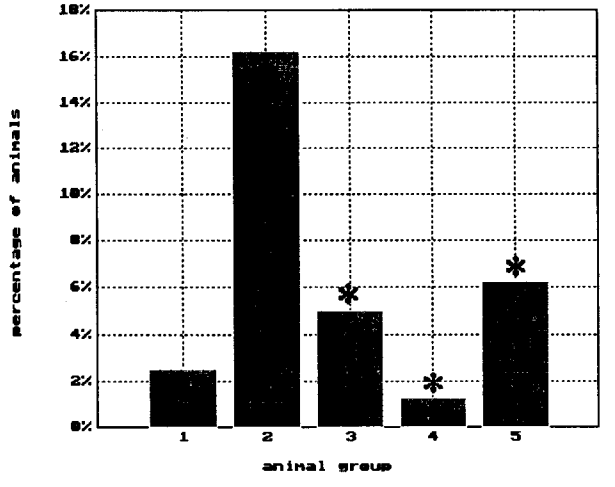

Figure 2. Leukaemia incidence.
* $P < 0.05$ for comparison with group 2.

SELENIUM PLUS GREEN ALGA MOMOTARU E-25 EXPERIMENT

The experiment involved 200 white rats divided into four groups. Group 1 was given a standard diet and no treatment (control). Groups 2, 3 and 4 were exposed to 6.5 Gy of gamma radiation and to incorporated iodine-131. After external irradiation was completed, groups 3 and 4 began to receive Momotaru E-25 and group 4 additionally got Selena (a Finnish preparation) at a dose of 30 ug selenium a day per capita. The animals were followed up for 2.5 years till their natural death. The exposed rats from groups 2, 3 and 4 had leukaemias, cancers and benign tumours, with the death rate increased.

Selenium supplementation of the diet (group 4) resulted in a longer lifespan (Figure 3). No antagonism between selenium and Momotaru E-25 was observed.

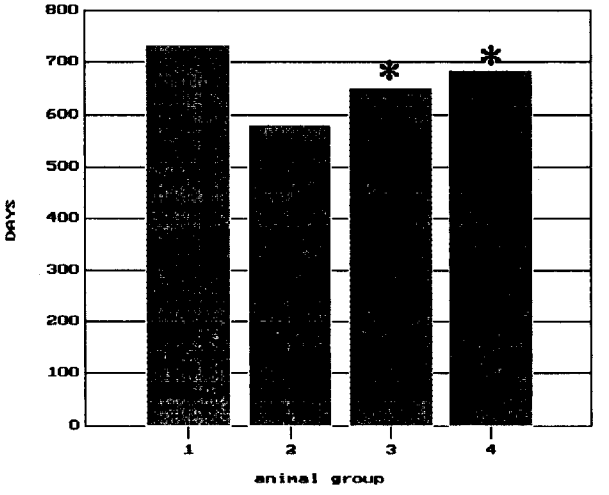

Figure 3. Rat lifespan.
* $P < 0.05$ for comparison with group 2.

CONCLUSION

A diet enriched with non-toxic doses of selenium and Momotaru E-25 caused a longer average lifespan and a 2 - 4 fold decrease of leukaemias and other malignancies, e.g. breast, thyroid and lung cancers, etc., at late times. In the groups with selenium and Momotaru E-25 supplementations, latent periods were longer than in the exposed control given no preparations.

The anticarcinogenic effect of selenium doses applied is on the average equal to the prevention of excess tumors from an effective dose equivalent of at least 1.0 Sv.

REFERENCES

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2. M. L. Foegh et al., J. Parenteral Enteral Nutr. 5, 218 (1990).