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Editorial

Bioassays at Low Doses of Ionizing Radiation

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EDITORIAL

One of the major challenges today is to understand the effects of low dose ionizing radiation on living things, both for the protection of the environment and for health. The applications of Ionizing Radiation, in agriculture and horticulture, and in space science, in the prevention and treatment of diseases, in pest control are vast. Environmental preservation operations are integral parts of several studies throughout Brazil and worldwide. For this reason, the permanent orientation of the governmental authorities, is to conduct the operations looking for to avoid impacts and aggressions to the environment. Despite the new technologies that arise every year for the maintenance and care of the environment, the contamination of this is a constant concern of government agencies that are looking for new methodologies to detect failures "left" by industries or monitoring, to that they can be used in a way that produces a benefit to man. For this search for environmental control and maintenance, over the years, monitoring and control methods for the environment have appeared.

The hypothesis of linearity between dose and effect and the absence of a dose threshold (LNT) remained in its original form for about a decade when W. Russell of Oak Ridge National Laboratory proposed to test its validity in rats. In his results, he observed that Timofeff's observation regarding the linearity of the phenomenon was not confirmed at low dose rates [1], the lower the dose rate, the higher the dose required to produce the same effect. The extreme of the phenomenon was observed in rat females, in which no genetic effect was detectable, if the dose rates were maintained sufficiently low.

The results obtained by Russel showed the existence of mechanisms that the cell uses to protect itself against the action of ionizing radiation and probably against other aggressors of the genetic material. These features were poorly visible when exposed to high doses and high dose rates, and were not considered when the LNT hypothesis was established. The linear relationship observed between the dose and the induction of mutant individuals from mature Drosophila sperm irradiation was justified by the high level of cell differentiation experienced by the sperm which, with virtually no cytoplasm and no cellular activity, loses the ability to repair of the genetic material they carry [2].

The existence of repair mechanisms for damage to the genetic material of the cells and the discrepancy observed between predictions of incidence of genetic effects, based on LNT-based models and experimental results, the discussion of how, without abandoning LNT, taking into account new evidence [3,4], together with the international bodies responsible for radiological protection guidelines. One of the controversial issues surrounding care for the environment and human health is the issue of low doses of ionizing radiation. In the early decades of the twentieth century, when ionizing radiations were already part of routine medical practices, it was premised on the existence of a dose threshold below which the risk of harm to the health of the irradiated individual was unlikely.

The premise was extended to the induction of leukemias and cancer, since until then, they had been observed only after the exposure of individuals to high doses of radiation [3,5]. Studies in the populations of Hiroshima and Nagasaki have contributed to confirm the hypothesis of LNT, although no hereditary effects attributable to nuclear explosions have been identified in the offspring of the irradiated populations. The significant increase in the incidence of leukemia and solid tumors in irradiated populations and the observed dose / effect relationship, even at low doses, confirmed the LNT hypothesis; also confirmed the induction of leukemias and cancers as the main effects produced in surviving populations [6].

In this context and in order to protect against the effect of radiation, in an admittedly prudent attitude, it was established that any dose, however small, posed a risk to the health of the irradiated individual (absence of a dose threshold) and that risk could be estimated based on observations made for high doses (Dose-Effect Linearity Hypothesis).

The Committee of the National Council for Radiological Protection and Measures - NCRP, also involved with the issue of validation of LTN for cancer in humans, in view of the lack of conclusive data on the issue, proposed to carry out an exhaustive bibliographic survey in the area of radiobiology, in order to verify the possibility of being established some generalities or raised some facts that would reinforce a reliability in the adoption of LNT, in this specific case [5].

In reports in which some credit was given for the "dose rate" effect, the questions related to how to introduce it into the estimates of risk coefficients and estimation of responses to extremely low dose rates [7-9].

In short, the issue of LNT, the dose-response issue, in the case of low doses, is still open, with its effects on environmental health of world interest and, as a consequence, on human health. Consistent technical and scientific experimental support is required to enable the relevant authorities to take specific radiological protection decisions. It is therefore of crucial importance to develop research projects focused specifically on low doses and their connection with the issues of protection against possible harmful effects of ionizing radiation on human health and on living things in general.

BIOMONITORING

Biomonitoring comes every year by taking up space in the scientific community, especially plant trials that make work easier from the point of view of legislation, in contrast to animal testing. The research with Vicia Faba [10,11] has been widely applied in genotoxicity and environmental pollution studies, with both micronuclei and comet assay tests [12]. The study on biomonitoring of controlled or supervised areas has been of great relevance for the evaluation of mutagenic effects at low dose rates on the environment, and consequently on human health.

The use of Biosensors has been gaining practical applications and giving opportunity for studies in the area. *Tradescantia* is one of them and presents peculiar characteristics, being also considered an optimal plant for the ornamentation, being easily manipulated and identified, providing reliable answers for experimental evaluation [13,14], several studies have been using this biosensor in studies of low doses of radiation and have demonstrated an excellent relation. When the energy from the ionizing radiation is deposited directly into the DNA, it can be damaged. There are numerous chemical and physical processes that can damage DNA in a variety of ways, but ionizing radiations are one of the few that can induce a number of damages, including beaded double breaks (DSBs). Factors that cause damage in a single strand probably help to promote the evolution of a double-stranded molecule as a genetic material - a second strand provides a model for the repair of damaged bases or nucleotides. Several copies of the chromosomes support additional DNA repair processes - for example, recombination homology (RH), which in many eukaryotes helps produce variation in haploid gametes cells during meiosis, is also involved in the repair of DSBs.

FINAL CONSIDERATIONS

The bioassays with Tradescantia can establish important information about the genetic effects of ionizing radiation and environmental mutagenesis, both for workers and the general public, as day-to-day Ionizing radiation is used in our day- to-day, is brings controversial issues, being this Biosensor another aid instrument, indicated for environmental monitoring, in the precaution of possible accidents on the environment [15-17]. The tests used with Biosensor Tradescantia are advantageous in terms of their ease of analysis (although requiring training), and of the low degree of uncertainty [18]. And since susceptibility to mutational damage is greater than that of the human organism [19], the Trad-MCN method, applied as an indicator of contamination, and associated with the use of biomonitoring techniques, becomes an ally essential in the relationship between Man and Technology.

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