Effects of several LET conditions on the mutation isolation system in fruit flies

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Heavy-ion beam mutagenesis is generally recognized as an effective method for mutation breeding[1, 2]. Although this method was greatly successful with plants, its application is limited for animals. Therefore, we plan to acquire more basic data to set up optimal conditions for the irradiation system by heavy-ion beam, using *Drosophila melanogaster* (fruit fly) as the model.

In a previous study, we developed and improved a stable mutant isolation system using fruit flies using carbon-ion beam irradiation. Then, we estimated the suitable state of the F1 progeny that includes a possibility of chromosome damage. It is important to know when the flies with high probabilities of DNA damage are born. Since DNA damage to important genes for survival can be judged by the homozygotes born in the F3 progeny, we measured a frequency of the lethal rate of the F3 progeny[3]. The progeny born 4 days after irradiation at 10 Gy dose levels recorded the maximum frequency of lethal rate[3].

In this report, we measured the survival and the lethal rates at 4-days samples with various linear energy transfer (LET) values of [22.5, 30, 50, 80, 100, 200, and 300 keV/μm] at different dose levels (1, 3, 10, 20, 30, 40, 60, and 80 Gy) using carbon-ion beam or argon-ion beam to estimate the influence of LET of heavy-ion beam on the biological effects.

Irradiated male flies were crossed with virgin female flies in the manner shown in reference 4. We focused on 4-days samples because they showed maximum frequency of lethal rate of the F3 progeny[3]. We compared the survival rate with those at different LET conditions. The survival rate decreases with increasing dose of LET irradiation (Fig. 1). When the strength of LET was beyond 100 keV/μm, the survival rate decreased remarkably, and the population of the F1 generation to establish mutant flies decreased sharply (Fig. 1). Furthermore, even when the exposure doses exceeded 20 Gy, survival rates decreased remarkably, and the population in the F1 generation decreased sharply.

Then, we compared the lethal rates at different LET condition. When the exposure doses exceeded 20 Gy, the lethal rates had high numerical values (Fig. 2). But these data could not establish the lethal mutants because there were only a few numbers of the F1 generation. In other words, it is impossible to search the mutant lines for large-scale screening, and it is impossible to estimate the good irradiation conditions.

The good exposure doses for the purpose of large-scale screening of mutant lines are 1-3 Gy. The good LET values for irradiation are 22.5-80 keV/μm (Fig. 1). In the case of 22.5, 30, and 50 keV/μm, the lethal rate for 3-Gy irradiation is higher than that for 1-Gy irradiation (Fig. 2). Thus, these data suggest that 3-Gy irradiation is better than any other condition. In the case of 80 keV/μm, the lethal rate for 1-Gy irradiation is higher than that for 3-Gy irradiation (Fig. 2). Therefore, these data suggest that 1-Gy irradiation is better than any other conditions.

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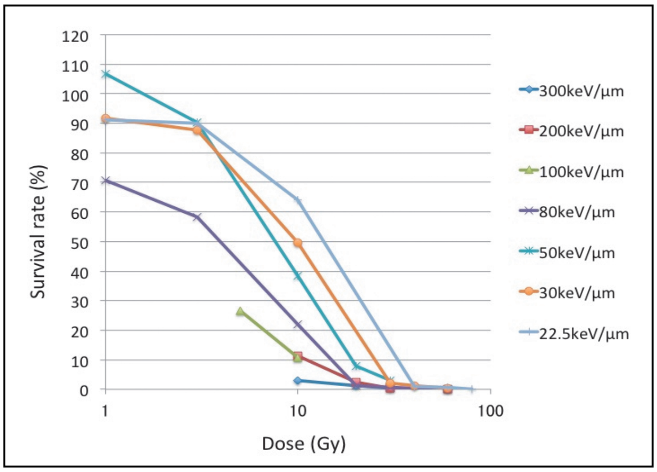

Fig. 1. Correlation between survival rate and exposure dose. Parental male flies were irradiated with carbon-ion beams (LET = 22.5, 30, 50, 80, 100 keV/μm) or argon-ion beams (LET = 200, 300 keV/μm). The frequency of survival rate of the F1 progeny is measured using 4-days samples.

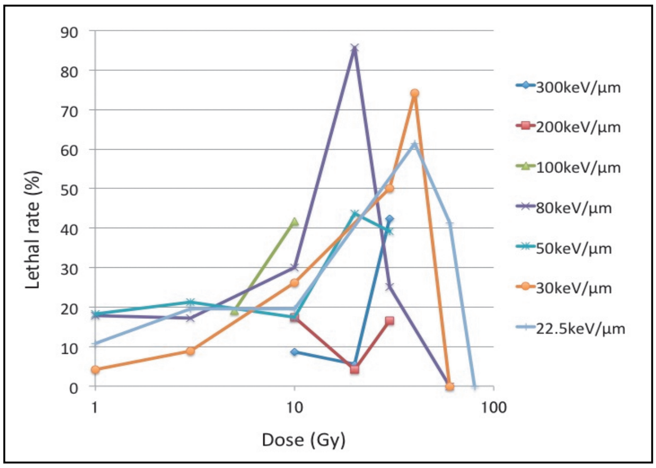

Fig. 2. Correlation between lethal rate and exposure dose. The frequency of lethal rate of the F3 progeny is measured using 4-days samples.

References

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