Purnima, U. and M. Sanjeeva Rao. Osmania University, Hyderabad, India. Studies on genetic effects of deuterium in Drosophila melanogaster.

The effect of deuterium on mammals was first observed in 1932 by Lewis who fed heavy water to mice and reported that the treated mice became sterile. Further, in treated males the spermatozoa were abnormal, while in pregnant females fetal abnormalities were reported. Hughes and Calvin (1958) reported the induction of sterility in mice fed deuterium.

Zamenhof and Demerec (1943) cultured flies on a medium containing deuterium and reported the failure of this isotope to increase the lethal frequency. Hughes et al. (1963) subjected flies to a medium containing various concentrations of deuterium and observed its ineffectiveness in increasing the mutation frequency.

Deuterium inhibits the growth of some of the lower organisms such as green algae, E. coli, yeast and the molds Aspergillus and Penicillin (Katz, 1960). Deuterium, having twice the mass of ordinary hydrogen, differs from its common isotope more sharply than any other rare non-radioactive isotope, and, since hydrogen is the most common element in biological systems, experiments were undertaken to assess the genetic effects, if any, produced by deuterium.

The present investigation reports the study of deuterium in producing genetic effects in Drosophila by culturing for four successive generations on a medium containing the same.

Individuals of the Oregon-K strain were allowed to feed on a normal medium containing 30% deuterium. Half of the males developed on this medium were crossed to y sc^{S1} In49 sc^{8};bw;st virgin females to screen the incidence of sex-linked recessive lethals and translocations. A brood pattern of 3 days interval was used and 3 broods were studied. Each male was allowed to mate with 3 females. The F_1 females were mated individually with y sc^{S1} In49 sc^{8} males, while the F_1 males were mated inidvidually with bw st virgins to score for sex-linked recessive lethals and translocations, respectively. The other half of the males were allowed to feed on the medium containing 30% deuterium along with fresh females of Oregon-K. This was repeated for four generations. The results are presented in Tables 1 and 2.

Table 1. Frequency of sex-linked recessive lethals induced in a control (1) and in four generations of Drosophila cultured on medium containing 30% deuterium (2,3,4 and 5)

Sl		BROODS A			B			C			TOTAL		
No	Generation	T	l	%	T	l	%	T	l	%	T	l	%
1	Control	861	2	0.23	827	4	0.48	874	2	0.23	2562	8	-.31
2	F_1 treated	214	4	1.86	440	1	0.22	500	1	0.20	1154	6	0.57
3	F_2 treated	905	4	0.44	196	1	0.56	549	1	0.18	1650	6	0.54
4	F_3 treated	249	2	0.803	182	2	1.22	163	2	1.22	594	6	1.1
5	F_4 treated	293	1	0.34	531	2	0.38	316	4	1.25	1140	7	0.61

T = total number of X chromosomes tested l = lethals recorded

Table 2. Frequency of translocations in a control (1) and induced in four generations of Drosophila cultured on a medium containing 30% deuterium (2,3,4 and 5)

Sl		BROODS A			B			C			TOTAL		
No	Generation	T	t	%	T	t	%	T	t	%	T	t	%
1	Control	849	0	-	846	-	-	832	0	-	2527	0	-
2	F_1 treated	290	1	0.34	293	1	0.34	240	0	-	823	2	0.24
3	F_2 treated	630	1	0.15	108	2	1.8	173	0	-	911	3	0.32
4	F_3 treated	183	1	0.54	99	1	1.01	107	0	-	389	2	0.51
5	F_4 treated	178	1	0.46	126	0	-	253	0	-	557	1	0.17

T = total number of F_1 sons tested t = translocations recorded

A chi-square test has been done to compare four groups, control vs F_1, F_2, F_3 and F_4. The results of this statistical analysis are presented in Table 3. Comparison of the data obtained for each generation gave evidence against a mutagenic effect of deuterium.

(Table 3 next page)

Rajaraman, R. and O.P. Kamra. Dalhousie University, Halifax, N.S., Canada. On Ruby laser mutagenicity to Drosophila melanogaster male germ cells.

In the past decade lasers emitting at different wavelengths have been employed to study the interaction of monochromatic radiations on various biological systems. Biological effects of laser radiations depend on their wavelength, energy density as well as the pigmentation and absorbance of the target (Rajaraman and Kamra, 1970). Ruby laser (RL)-induced (6943Å) changes in somatic cells have been reported by several workers. Contradicting observations like growth enhancement by increase in cell division (Jamieson et al., 1969), blockage of mitosis in prophase and retardation of growth by cell division (Gordon et al., 1968) in mammalian cells in culture due to RL radiation have been reported. Chromosomal clumping and aberrations were observed in RL irradiated rabbit endothelial cells (Okigaki and Rounds, 1972). Exposure of D. melanogaster larvae to unfocused RL (0.1J/mm^2) produced significant variations in the life span of different stages that were transmitted as true breeding mutations (Zuzolo, 1966). In view of these observations, we decided to test the mutagenicity of RL radiation in D. melanogaster by screening for sex-linked recessive lethals.

Male Drosophila larvae of X^{c2} y/sc^8 Y stock were collected from the culture tubes when they were climbing up for pupation and were allowed to pupate on moist filter paper. 24 hrs old male pupae were irradiated with 5 or 10 pulses of RL radiation (217 mJ/pulse) to sample the spermatids which are most sensitive to radiation damage. The pupae were arranged during irradiation so that only the posterior ventral part of the pupae were exposed to radiation, to avoid unnecessary damage to the thoracic and head regions. On emergence, the males were individually mated with six 3-day old y sc^{S1} In-49 sc^8;bw;st p^p virgins for two days. The F_1 offspring were screened for lethal mutations. The treatments and the results are shown in the table.

Treatments	No. chrom. tested	No. lethal	% lethal
Control (a)	383	0	0.1
(b)	473	1	
5 x 217 mJ (a)	431	0	0.0
(b)	394	0	

It is apparent that RL radiation did not induce sex-linked recessive lethal mutation even in the spermatid stage, which is most sensitive to radiation damage. The males that were exposed to 10 pulses of 217 mJ showed temporary sterility (for two days) indicating that either the males were not able to mate due to any possible injury by irradiation or the germ cells in spermatid stage were killed, fertility being regained by repopulation due to continuously maturing germ cells. These results indicate that RL radiation is not mutagenic as regards to sex-linked recessive lethals and it may cause cell death or division delay in the spermatogenous cells probably due to secondary heat damage.

References: Gordon, T.E., C.A. Waldron and L.S. Gordon, Cancer 25:851; Jamieson, C.W., M.S. Litwin, S.E. Longo and E.T. Krementz 1969, Life Sci. 8:101; Okigaki, T. and D.E. Rounds 1972, Radiat. Res. 50:85; Rajaraman, R. and O.P. Kamra 1970, Photochem. Photobiol. 11:121; Zuzulo, R.C. 1966, NASA Rep. 1-66-1:1.

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Table 3. χ^2 values for the differences of sex-linked recessive lethals for generations compared

S1 No	Group	BROODS A	B	C	TOTAL
1	Control vs F_1 treated	5.58	1.35	0.403	0.9142
2	Control vs F_2 treated	0..21	0.272	0.610	0.07997
3	Control vs F_3 treated	0.523	0.208	1.437	5.317
4	Control vs F_4 treated	0..21	0.546	3.124	1.7804