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DNA feeding and directed mutagenesis in *Drosophila melanogaster*

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SUMMARY

The mutagenic effects of feeding calf-thymus DNA to larvae of *Drosophila melanogaster* have been studied on second chromosome recessive lethals, sex-linked dominant and recessive visibles and dominant autosomal visible mutations. While a positional specificity of DNA-induced lethals has been confirmed, no evidence has been obtained for a preponderance of visible mutations or for a specificity of phenotype among the visibles.

Gershenson (1965, 1966) found that an admixture of calf-thymus DNA to the food of Drosophila larvae is mutagenic and that the mutations are not random in the following three respects:

(1) Lethals occur on the 2nd chromosome but not in the *X*; this claim was confirmed by Mathew (1965) in experiments in which the *X* and the second chromosome came from the same treated males so that variation in treatment was avoided. Actually, his data do not exclude a very small mutagenic action on the *X*, much smaller than on chromosome II.

(2) The majority of the lethals on chromosome II occur in a narrow region near the centromere and form a pattern of overlapping deletions. This, too, was partially confirmed by Mathew (1965) as far as his much smaller sample of lethals permitted; for the frequency of allelism between lethals in different males was higher than expected if the lethals had been randomly distributed over the chromosome.

(3) The most striking specificity concerns visible mutations (Gershenson & Kiselyeva, 1958; Gershenson, 1966). Not only were they more frequent than lethals; they were found even in the *X*-chromosome in which the same treatment had not produced any lethals. Of 21 genetically identified visibles, no less than five were sex-linked; the remaining 16 were autosomal dominants. Most surprising of all was the finding that the majority of all visible mutations (genetically identified as well as non-identified ones) affected wing characters. Mathew (1965), on the other hand, found very few dominant visibles; but his experiments were not specifically designed to score visible mutations.

A phenotypic specificity of this kind was so unprecedented and of such high theoretical and practical interest that independent confirmation of it on a different strain and in a different laboratory seemed desirable. Dr Gershenson kindly let me have a sample of his DNA and the experiment was carried out on an Oregon K strain, following Gershenson's procedure as closely as possible.

Treated P_1 males that had developed on food containing 13% DNA were mated to attached-*X*, Curly virgin females. The F_1 males were scored for sex-linked dominant and recessive visibles and for autosomal dominant visible mutations. A sample of Curly F_1 males was tested for induced second chromosome lethals by the Cy/L technique as a measure of effectiveness of the treatment.

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In 581 second chromosomes from 59 treated males, 12 lethals were detected. The distribution of lethals in the treated males was as follows: one male with three lethals, one male with two lethals and seven males with one lethal each. The lethals were tested for allelism by intercrossing. Since allelic lethals from the same male probably represent products of a single event, only one lethal from each male was used. Of the 36 possible crosses between the nine lethals, 11 did not yield any wild-type flies. The percentage of lethals that are induced in the same narrow region of the second chromosome thus works out as 30·55. The degree of allelism between lethals of independent origin found in these experiments is significantly higher than that expected from their random occurrence. This confirms the findings of Gershenson (1965) and Mathew (1965). No attempt was made to locate the lethals.

Among 14,845 F_1 sons of treated males carefully examined for visibles, only seven mutations were obtained. These consisted of six Minutes and one Beadex. A large number of other morphological variants such as flies with blistered wings, stubbly bristles and nipped scutellar bristles proved, on testing, to be non-hereditary variations. The frequency of visible mutations obtained in the DNA-fed series is within the range normally expected in an untreated population. There was no preponderance of wing mutations.

In summary, while my results are in agreement with the positional specificity of lethals, they provide no evidence for a preponderance of visible mutations or for a specificity of phenotype among visibles. The former type of specificity might be due to a tendency of calf-thymus DNA to attach to specific chromosomal regions and interfere with their replication (Mathew, 1965); this is the more likely as regional specificities have been found also for the production of Minutes by other macromolecules (Fahmy & Fahmy, 1965). Phenotypic specificity of the kind observed by Gershenson and his collaborators is very difficult to explain. The fact that no such specificity was found in my experiments nor in those carried out for a different purpose by Mathew suggests that its basis, too, is regional. Possibly, in Gershenson's strain some chromosomal regions that interact specifically with calf-thymus DNA carry genes concerned with wing development.

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