A NOTE ON INDUCED STERILITY IN MINK

OLE VENGE

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Summary. Three groups of ten mink males were each irradiated one, two and three times with a dose of 500 r at each treatment. The irradiation caused a very high degree of sterility. When the males were bred to non-irradiated females, a clear dose effect was observed. Histological examinations of the testes showed pronounced degeneration and destruction of the spermatogenic tissue. The induced sterility is very similar to that found in the homozygous Stewart mink male.

INTRODUCTION AND METHODS

In an attempt to induce mutations in the mink, a total of thirty males, fifteen of the Royal Pastel type and fifteen of the Standard type, were exposed to X-rays. In Group 1, five males of each type were irradiated three times with a dose of 500 r at each treatment. The first irradiation was carried out on 19th January, the second treatment followed on 6th February and the third on 24th February. In Group 2, ten males, five of each type, were irradiated twice, on 7th and 25th February, also with a dose of 500 r at each treatment. Finally, the males in Group 3 were exposed to X-rays (500 r) only once, on 26th February. In order to be sure that only the testicles were subjected to the X-rays, the animals were anaesthetized by intraperitoneal injection of a barbiturate anaesthetic immediately before the treatment. The males were used for breeding 3 weeks after the last treatment and onwards, until the end of the breeding season. Within each group fifteen females were Royal Pastels and fifteen Standards.

The different doses and the different dates of irradiation were chosen partly because nothing is known about the sensitivity of mink males to X-rays, and partly because it was believed that it should be possible to throw some light on which stages in spermatogenesis should be easiest to attack (disregarding a possible dose effect) for the induction of mutations. Irradiation at the different dates would, of course, affect all stages in spermatogenesis, but due to the duration of the whole process of spermatogenesis and the short mating season (15th to 25th March), treatment towards the end of February would be of no significance as no ripe spermatozoa would arise from the affected spermatogonia. In other words, from a breeding point of view, in Group 1 all stages of spermatogenesis could be affected, in Group 2 only primary spermatocytes and more advanced stages would be attacked, while in Group 3 only spermiogenesis would be treated. It can be mentioned that after three breeding seasons with

matings between related animals, e.g. parent-offspring, brother-sister, etc., no new mutant has appeared in the stock.

RESULTS

The result of the irradiation was that in all three groups a high degree of sterility was induced. The breeding results are summarized in Table 1. In Group 1, only 58% of the females were mated (one female died), due to difficulties with the males, especially the Standard males. Of the seventeen mated females, only one gave a litter of two young. In Group 2, 80% of the females were mated and four litters were born with a total of five whelps, one of which was stillborn. Finally, in Group 3 87% of the females were mated, but only

TABLE 1
BREEDING RESULTS. NORMAL FEMALES BRED TO IRRADIATED
MALES

Group	No. females			No. whelps		'Empty' females (%)
	Total	Mated	With litters	Total	Stillborn	
1 Standard Pastel	15	5	—	—	—	100.0
	14	12	1	2	—	91.7
	29	17	1	2	—	94.1
2 Standard Pastel	15	11	4	5	1	63.6
	15	13	—	—	—	100.0
	30	24	4	5	1	83.3
3 Standard Pastel	15	13	3	9	—	76.9
	15	13	4	6	3	69.2
	30	26	7	15	3	73.1

seven females out of thirty became pregnant. The total number of whelps was fifteen, three of which were stillborn. No spermatozoa were found at the semen test which was carried out on vaginal secretions immediately after copulation. The increase in 'empty' females with increasing doses can be taken as an example of dose effect.

It can be mentioned that the normal breeding result is 2 to 4% unmated females (failure of mating being due to the females), a litter size of 5.1 and 10 to 15% 'empty' females, with the same breeding system as that applied to the experimental animals.

The dose effect can also be seen from the histological pictures. In the first group (1500 r), histological examination revealed an extreme degeneration of the spermatogenic tissue; that is, not only spermatogonia (A and B), but also primary and secondary spermatocytes as well as spermatids have disappeared (Pl. 1, Figs. 1 and 2). In the epididymis, a small number of spermatozoa was found in a few animals. Apparently, these spermatozoa have survived from December or January.

In Group 2 (1000 r), almost the same picture as in Group 1 was seen (Pl. 1, Figs. 3 and 4). The destruction of the seminiferous tubules was almost complete. The number of spermatozoa in the epididymis seemed to be a little higher. In a few tubules, however, it looked as if a small number of spermatogonia had survived the treatment.

In the third group, which received only 500 r, the damage or degeneration was less drastic, but as can be seen from Pl. 2, Figs. 5 and 6, a high degree of degeneration was also induced in this case. The general histological picture here was that spermatozoa were found in the lumen in some tubules, but the number of spermatids was extremely low. The spermatogonia and spermatocytes were also affected, but not to the same extent as by a higher dose. Cell divisions were observed in some cases, and in the epididymis several spermatozoa could be seen. Probably, most of the spermatozoa were dead (*see* the breeding results in Table 1). An impression of the induced degeneration in the seminiferous tissue is perhaps best attained by comparing the histological pictures from irradiated animals with that from a normal male in about the same age. The normal picture from a 10-months-old male is shown in Pl. 2, Figs. 7 and 8.

DISCUSSION

In mink, spermatogenesis ends in April and the tissue in the seminiferous tubules degenerates rapidly. During summer and autumn, only a few gonocytes can be observed. However, the tubules diminish in size, the lumen disappears and a single tubule is filled up with cells (Pl. 3, Figs. 9 and 10) (Lundh, 1961). The degeneration observed under normal conditions is of quite another type than that observed after irradiation. Whether the tissue in irradiated animals would regenerate or not is unknown, but most probably the degeneration is complete and permanent.

The induced sterility is very similar to the sterility in the homozygous Stewart mink. The Stewart gene has a typical pleiotropic effect, causing sterility when homozygous and giving a much lighter fur, due to an increase in the number of white hairs, an increase in the white spots and a much lighter underfur than in mink not carrying the gene. The effect on the fur is a simple additive one, the homozygote being much lighter than the heterozygote, but the effect on the testis, i.e. on the spermatogenic tissue, is recessive. The heterozygote has a normal fertility. In Pl. 3, Figs. 11 and 12 is shown the histological picture of the testes of a homozygous Stewart male. It is easily seen that no spermatogonia are present. All the histological preparations that have been examined in our laboratory show exactly the same picture. The similarity between the histological preparations from the Stewart mink and males from Group 1 and 2 is striking. At one point there seems to be a difference between the homozygous Stewart male and the irradiated ones. In the Stewart mink, the libido is not affected at all. The sterility in homozygous Stewart males seems to be complete; among the females, a few (15% as a preliminary figure) are able to produce a litter.

The conclusion to be drawn from the present observation on the effect of irradiation of the testicles of mink is that a dose of 500 r will cause so low a fertility that it is close to sterility.

REFERENCE

- LUNDH, E. (1961) Testikel u treckling och cykliska förändringar i spermielbildningen hos mink. (Studies on testicular development and cyclic changes in the spermatogenesis in the mink.) *Våra Pälstdjur*, 32, 380.

EXPLANATION OF PLATES

PLATE 1

- FIG. 1. Section of a testicle from a mink male exposed to 3×500 r. Note the 'empty' tubules. Obj. 3·8 (scale in millimetres); Eosin-haematoxylin (E-H).
- FIG. 2. Part of a single tubule from the same animal as in Fig. 1. Note the complete absence of spermatogenic tissue. Obj. 40 (scale in millimetres); E-H.
- FIG. 3. Section of a testicle from a mink male exposed to 2×500 r. The degeneration of the spermatogenic tissue is easily seen. Obj. 3·8; E-H.
- FIG. 4. A single tubule from the same male as in Fig. 3. Note the large vacuoles in the membrane and the absence of spermatogenic tissue. Obj. 40; E-H.

PLATE 2

- FIG. 5. Section of a testicle from a mink male exposed to 500 r. In most tubules the degeneration of the spermatogenic tissue is almost complete. Obj. 3·8; E-H.
- FIG. 6. Part of a single tubule from the same male as in Fig. 5. Note the degeneration in the spermatogenic tissue. In the lumen spermatozoa can be seen. Obj. 40; E-H.
- FIG. 7. Section of a testicle from a normal fertile mink male. Obj. 3·8; E-H.
- FIG. 8. Section of a tubule from the same male as in Fig. 7. All stages in spermatogenesis can be seen. Obj. 40; E-H.

PLATE 3

- FIG. 9. Section of a testicle from a normal mink male 2 months after the beginning of the breeding season. The lumen is filled with cells in most tubules. (From Lundh, 1961). Obj. 3·8; E-H.
- FIG. 10. A single tubule from the same male as in Fig. 9. Note the disappearance of the lumen. Obj. 40; E-H.
- FIG. 11. Section of the testicle from a homozygous Stewart (ww) mink male. Compare with Figs. 1 to 6. Obj. 3·8; E-H.
- FIG. 12. A single tubule from the same male as in Fig. 11. Note the absence of spermatogenic tissue. Compare e.g. with Figs. 3 and 4. Obj. 40; E-H.

PLATE 1

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PLATE 2

PLATE 3