SOME ASPECTS OF MEIOSIS IN NORMAL AND ROBERTSONIAN TRANSLOCATION-CARRYING RAMS

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ABSTRACT

SOME ASPECTS OF MEIOSIS IN NORMAL AND ROBERTSONIAN TRANSLOCATION-CARRYING RAMS

A study was made of the meiotic chromosomes in air-dried preparations from 35 genitally sound rams (Ovis aries). The quantity and quality of dividing cells were best when testicular material was obtained by castration under local anaesthesia from rams during their breeding season. Sodium tri-citrate solution was used as hypotonic treatment and the cells were fixed in suspension with glacial acetic acid and absolute alcohol plus a trace of chloroform. Slides were stained either with aceto-orcein or with Giemsa for a "C-banding" technique. Fourteen of the rams had a normal mitotic karyotype (54,xy) and the remainder were heterozygous or homozygous carriers of a Massey I, Massey II or Massey III Robertsonian translocation and had the following mitotic karyotypes: 53,xy,t(5q26q); 52,xy,t(5q26q) + (5q26q); 53,xy,t(8q11q); 53,xy,t(7q25q); 52,xy,t(7q25q) + (7q25q). One ram was heterozygous for both the Massey I and Massey III Robertsonian translocations.

Analysis of primary spermatocyte cells showed that a modal number of 27 chromosomal elements was present in normal rams, while in both heterozygous and homozygous Robertsonian translocation-carriers, a modal number of 26 chromosomal elements was recorded. Heterozygous carriers of the three types of Robertsonian translocations, which involved non-homologous chromosomes, were characterized by the presence of a trivalent in cells at the diplotene, diakinesis and metaphase I stages. The modal number of chromosomal elements was recorded in over 80 per cent of the cells at diakinesis and metaphase I in the heterozygous and normal rams while over 77 per cent of the cells in the Massey I homozygote and 90 per cent of the cells in the Massey III homozygote had modal counts. An association between the sex bivalent and a small autosomal bivalent was recorded in 7.5 per cent of the diakinesis-metaphase I cells from normal rams and in between 3.4 and 4.7 per cent of the cells from the translocation-carrying rams. Separation of the sex chromosomes was observed in 0.5 to 1.5 per cent of the diakinesis-metaphase I cells in both Robertsonian translocation-carrying and normal rams. However no evidence at metaphase II of the

sex chromosome aneuploidy expected if the two univalents disjoined at random at first anaphase was observed.

Eighty seven metaphase II figures from normal rams and 1,146 metaphase II figures from Robertsonian translocation-carrying rams were recorded. Detailed analysis of 1,131 cells showed that over 80 per cent of the non-polyploid metaphase II figures from the normal and homozygous rams had euploid chromosome arm counts. In contrast between 54 and 67 per cent of the metaphase II figures from the heterozygous rams were euploid. No hypermodal cells were recorded at metaphase II in either the normal or homozygous rams but from 4.5 to 9.2 per cent of the metaphase II cells in the three types of heterozygous ram were hypermodal. The results obtained in this thesis showed that the proportion of cells with chromosome arm counts of 29 was higher in the heterozygotes than in the normal or homozygous Robertsonian translocation-carrying rams. There were significantly greater numbers of cells with 29 chromosome arms than with 31 chromosome arms in the three heterozygote classes which suggested that chromosome loss due to lagging at first anaphase or technical manipulation, must have occurred in addition to non-disjunction. Statistically significant differences in chromosome arm distributions were shown to exist between rams which were heterozygous for a particular translocation and rams which were homozygous for the same translocation or normal rams. In addition to differences between individual rams, a significant difference between the Massey II Robertsonian translocation and the Massey I and III Robertsonian translocations occurred. Fewer balanced translocation X-bearing metaphase II cells were recorded than expected in three of the four Massey II Robertsonian translocation heterozygotes. Non-translocation bearing X and Y cells predominated at metaphase II in the three translocation types when total metaphase II counts were considered, and greater than expected numbers of X-bearing cells were found in both the euploid and aneuploid classes in the Massey III Robertsonian translocation heterozygotes.

Since the majority of normal ewes mated with Robertsonian translocation heterozygous rams conceived to their first service, and because no lambs with unbalanced karyotypes associated with a Robertsonian translocation have been recorded, it is suggested that only

chromosomally balanced (euploid) spermatozoa are involved in fertilization. It is further suggested that the absence of unbalanced karyotypes in progeny is explicable on the basis of a degeneration of aneuploid spermatocytes occurring prior to their maturation.

The three translocations in the homozygous state behaved as normal autosomal bivalents at meiosis with regular segregation at anaphase I.

It is suggested that the lowered fertility seen in matings involving heterozygous rams and heterozygous ewes cannot be attributed to any deficiencies in the spermatogenic function of the ram.

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