A CHROMOSOME TRANSLOCATION AND FAMILIAL SUBFERTILITY IN CROSSBRED COWS

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SUMMARY

Cytogenetic analysis of a family of subfertile Limousin/Jersey cows revealed the presence of an X - autosome translocation. The autosome involved was identified as one of pair 22 on the basis of G - banding and per cent total complement length evaluation (% TCL). Breeding attempts on the translocation carriers with various reputed A.I. bulls resulted in abortions, stillbirths and repeat breeding. These reproductive problems are attributed to embryonic death due to chromosomal imbalance in the female gametes produced.

INTRODUCTION

In cattle structural chromosomal alterations of the Robertsonian type are known to cause varying degrees of subfertility (Long, 1985). Information on the effect of other types of structural chromosome anomalies on fertility is not well documented. The present report describes the occurrence and impact of an X - autosome translocation on reproductive performance in a family of Limousin/Jersey crossbred cows.

MATERIALS AND METHODS

Animals

A herd of subfertile Limousin/Jersey cows (75:25 respectively) showing regular oestrous cycles was studied. Their reproductive history prior to this study was characterised by several abortions, stillbirths and repeat breeding. Their return to service occurred generally between 30 and 35 days. No evidence of genital tract defect, infection or hormonal imbalance was apparent as verified by periodic rectal examinations, hormonal assay and microbial tests. A group of fertile Limousin/Jersey crossbred cows were used as control.

Chromosome Studies

Metaphase chromosome spreads were obtained from both lymphocyte and fibroblast cultures according to a slight modification of standard procedures (Basrur, 1984). Some of the air-dried slides were stained directly in filtered 2% acetic orcein while others were subjected to modified Giemsa-banding a week later (Seabright, 1971). Chromosome preparations free of overcontraction and differential stretching were selected for morphometry using the MOP - Kontron AMOC - 3 equipment consisting of a measuring tablet, a mechanical stylus and an automatic recorder - printer. Chromosome measurements were carried out on

photo-karyotypes all enlarged to a standardised final magnification of X3000 (Wurster et al. 1971).

Breeding

The X-autosome translocation carriers were bred artificially by trained technicians to A.I. bulls. On several occasions, embryo transfer was attempted following superovulation, breeding and embryo evaluation (Linares et al. 1980).

RESULTS

The modal chromosome number was 2n = 60 (including the XX sex complement and 29 autosomal pairs) on the basis of 240 metaphase spreads examined. However, karyotype analysis consistently indicated a translocation involving one of the X-chromosome and one of the medium size autosomes (pairs 19 - 24; Figure 1). Mean per cent TCL values suggested that the autosomal segment on X_T (translocated X) and the "minute" chromosome (A_T) may have both originated from one of the autosomes in pairs 21 - 24. Analysis of the G - banded karyotypes in accordance with the Reading protocol (Ford et al. 1980) indicated that the affected autosome may have been one of pair 22 (Figure 2). Karyotype analysis of the cows with normal fertility indicated no gross chromosomal alterations. The numerous breeding attempts including the embryo transfer procedures resulted mostly in abortions and persistent repeat breeding. However, four offspring comprising two male and two female calves were born. Only one of the female calves carried the X-autosome translocation, all the others showed normal karyotypes. Morphological evaluation of the embryos collected for transfer (at 6 days) showed most of them to be defective under phase contrast and transmission electron microscopy.

DISCUSSION

The implications of heterozygosity for an X-autosome translocation in cattle are, as yet, not clear due mostly to the rarity of the condition in this species. Very low fertility in one report (Gustavsson et al. 1968) contrasted with almost unimpaired fertility in another study (Eldridge, 1980). In principle, the X-autosome translocation carriers in the present study would be expected to produce some (50%) chromosomally unbalanced ova. It is therefore plausible to anticipate that some of the resulting embryos would be unviable (Basrur et al. 1984). Since no extrinsic factors capable of interfering with normal fertility could be detected, it seems reasonable to suggest that the subfertility noted in the X - autosome carrier cows may be casually related to the chromosome translocation.

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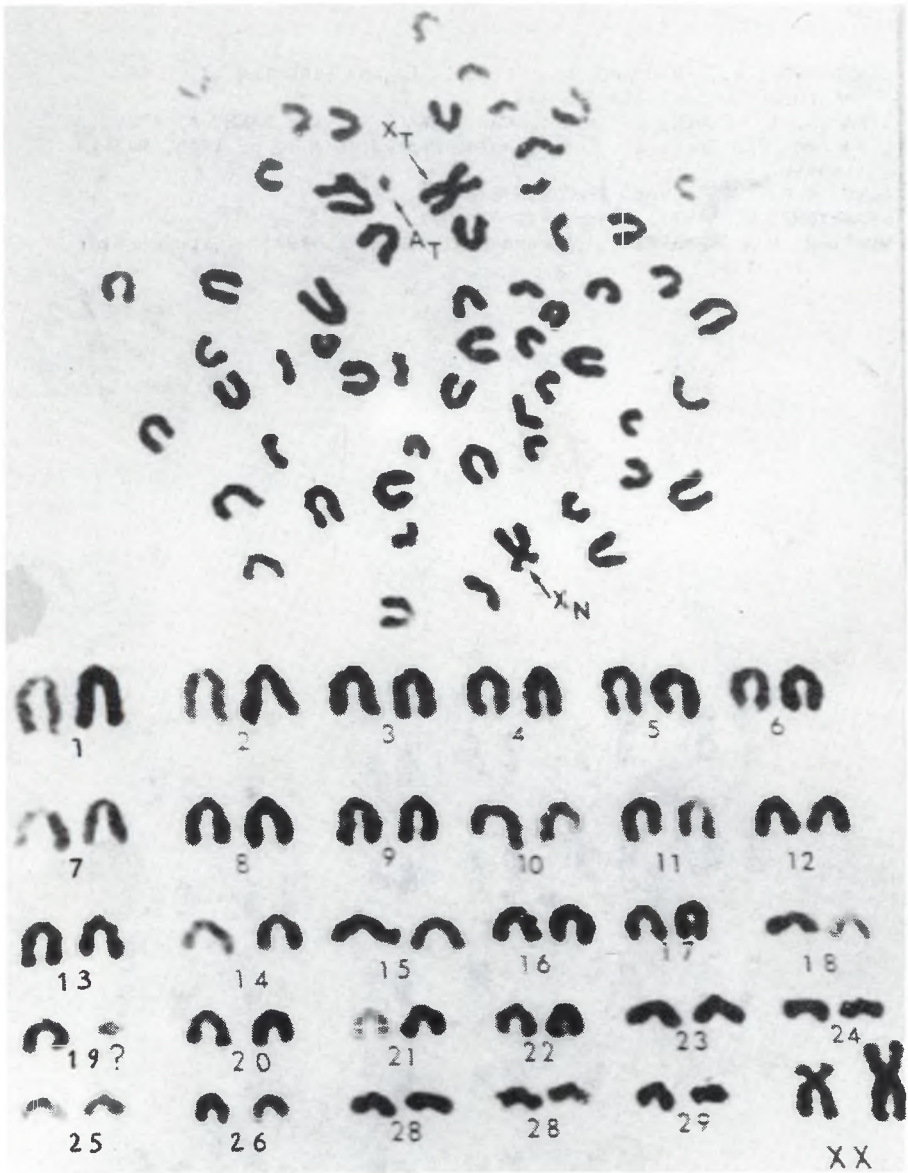

Figure 1 Representative metaphase spread and karyotype of the presumed X-autosome rearrangement.

Note one of the X chromosomes (X_T) which is larger and metacentric as well as a "minute" chromosome A_T (arrowed).

X_N ..... normal submetacentric X chromosome.

X_T ..... translocated X autosome - (minute).

A_T ..... translocated autosome - (minute). Orcein stain. X2200.

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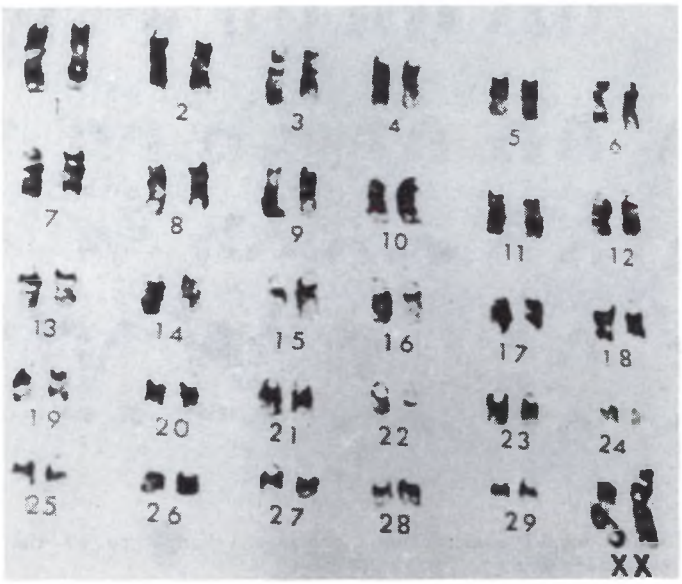

Figure 2

G - banded karyotype of one of the X-autosome translocation carriers. Giemsa-stained following 0.25% trypsin pretreatment. X2500.