The meiotic chromosomes of Creole cattle from Guadeloupe

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RÉSUMÉ

SHARMA (A.), POPESCU (C. P.). — Les chromosomes méiotiques des bovins de race Créole de la Guadeloupe. *Rev. Elev. Méd. vét. Pays trop.*, 1985, **38** (4) : 353-357.

Une étude des chromosomes méiotiques a été effectuée chez les bovins de race Créole de Guadeloupe. Elle a porté sur 8 taureaux phénotypiquement normaux, âgés de 18 mois. Les cellules au stade de diakinèse ont montré 30 bivalents ayant, en moyenne, 58,24 chiasmata par cellule. Le bivalent sexuel est le plus grand du complément et montre une association de type bout-à-bout entre les chromosomes X et Y. Différentes hypothèses invoquées pour expliquer le taux réduit de vêlage des croisés *Bos taurus* et *Bos indicus* sont discutées.

Mots clés : Bovin Créole - Chromosomes - Guadeloupe.

SUMMARY

SHARMA (A.), POPESCU (C. P.). — The meiotic chromosomes of Creole cattle from Guadeloupe. *Rev. Elev. Méd. vét. Pays trop.*, 1985, **38** (4) : 353-357.

Cytogenetic studies were made on the bahaviour of meiotic chromosomes of Creole cattle from Guadeloupe. Eight bulls phenotypically normal, 18 month old were employed for this study. Bulls at diakinesis showed 30 bivalents with 58.24 average total chiasmata per cell. The sex bivalent was larger as there was end to end association between X and Y chromosomes. Several hypothesis on the causes of the low calving rate of crosses between *Bos taurus* and *Bos indicus* cattle are discussed.

Key words : Creole cattle - Chromosomes - Guadeloupe.

INTRODUCTION

The autosomes and X chromosomes of *Bos taurus* and *Bos indicus* are morphologically similar but the Y chromosome differs. The acrocentric Y chromosome of *Bos indicus* is similar to small autosomes, and that of *Bos taurus* is small metacentric chromosome.

It is observed that crossbreds between *Bos taurus* and *Bos indicus* fails to produce a hybrid which retains heterosis after F_1. The adaptation to heat and disease resistance is retained whereas the better fertility and high milk yield of *Bos taurus* breeds is lost. RENDEL (15) suggested that the low claving rate of crosses between *Bos taurus* cows and Brahman bulls in F_2 generations is due to a translocation between the Y chromosome and an autosome, or between Y and X chromosomes. He further suggested that such a translocation could set up a balanced polymorphism and perpetuate low calving rates against selection.

Keeping RENDEL's hypothesis in mind, this investigation was undertaken to study the meiotic chromosomes of male Creole cattle, which possesses a *Bos indicus* Y chromosome (5).

MATERIAL AND METHODS

The bulls used for this study were from the Experimental Farm of the National Institute for Agricultural Researches at Gardel, Guadeloupe (French West Indies, 16° north and 61° west).

At slaughter, the testicular material was collected from 8 bulls, phenotipically normal

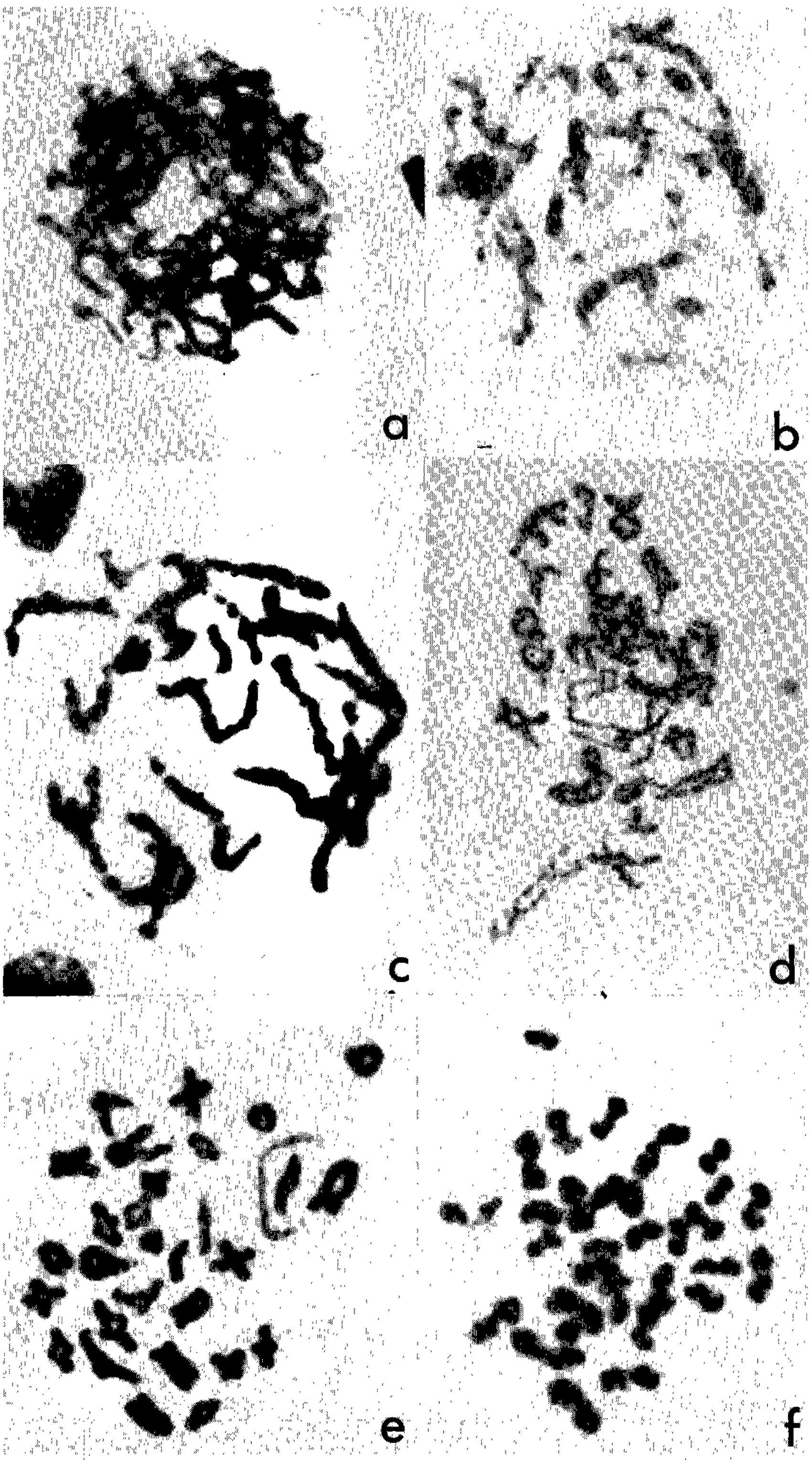


Photo 1. — Spermatogonial meiosis showing : a) Leptotene, b) Zygotene, c) Pachytene, d) Diplotene, e) Diakinesis and f) Metaphase 2.

and 18 months old. The chromosomes were prepared by modifying technique of EVANS *et al.* (3). The seminiferous tubules were carefully teased under stereomicroscope with the help of sharp needles. The cells were then treated with 0.85 p. 100 sodium citrate hypotonic solution for 10-12 min at 37 °C and fixed in acetic ethanol. Air dried slides were prepared which were later stained with 4 p. 100 Giemsa. The slides were thoroughly screened under Leitz microscope and photographs were taken in oil immersion.

Karyotypes were prepared from well spread diakinesis and average number of chiasmata per cell were calculated.

RESULTS

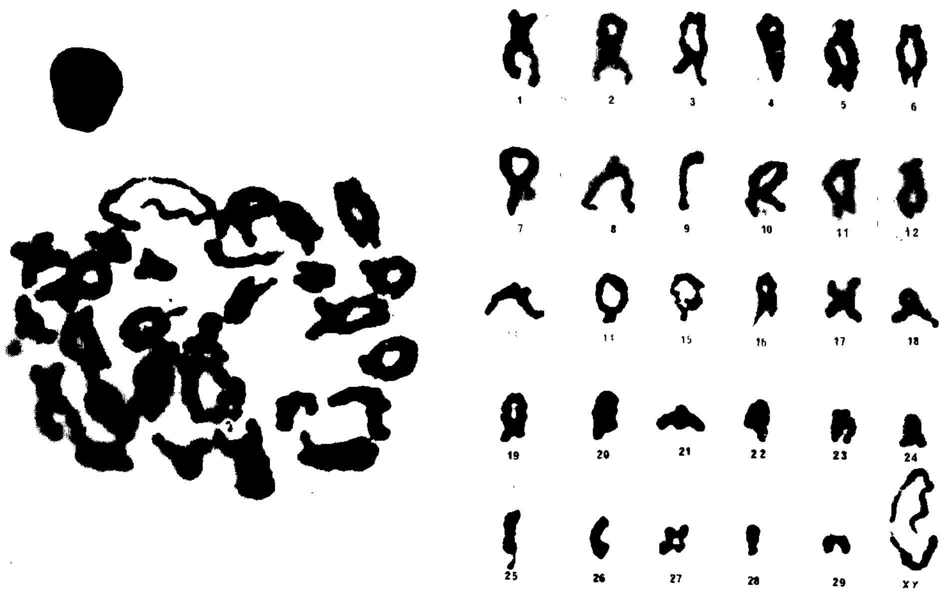
We observed that of the 8 Creole bulls examined all have chromosome count 2n = 60 in spermatogonial mitosis, so the number is regarded as characteristic of this species. Two principal types of spermatogonias were observed, and their respective divisions were similar to *Bos taurus* (9, 10, 13) ; leptotene showed thin chromatin material scattered randomly in the nuclear region (Photo 1 a). We could observe paired homologus chromosomes jumbled and overlapping each other in zygotene (Photo 1 b). Sexual vesicles were clearly visible in pachytene (Photo 1 c). Cells with diakinesis showed 30 bivalents in number (Photo 2 a, b). On an average 1-4 chiasmata were observed in each bivalent. The average total number of chiasmata per cell was 58, 24.

In all diakinesis observed the sex chromosomes were larger as there was end to end association (Photos 2, 3). It was observed that there was a dark band at the telomeric end of Y chromosome (Photos 2, 3). No translocation was observed between X and Y or between Y and autosome.

DISCUSSION

It is evident from all diakinesis examined that there is end to end association between sex chromosomes (Photo 3). The diakinesis also revealed that the long X chromosome has a chromomere rich thick telomeric region which pairs with homologous part of Y chromosome. The XY association was described as end to end in *Bos taurus* also by MELANDER and KNUDSEN (9), and by POPESCU (13).

We observed a dark band at the association point of XY bivalent (Photo 3 c, f, i). This dark band is probably the telomeric region of Y chromosome because HALNAN and WATSON (7) reported a dark band in the telomeric region of *Bos indicus* Y chromosome, which was not found in Y chromosome of *Bos taurus*. This



a b

Photo 2. — a and b, cell and karyotype of diakinesis stage showing 30 bivalents.

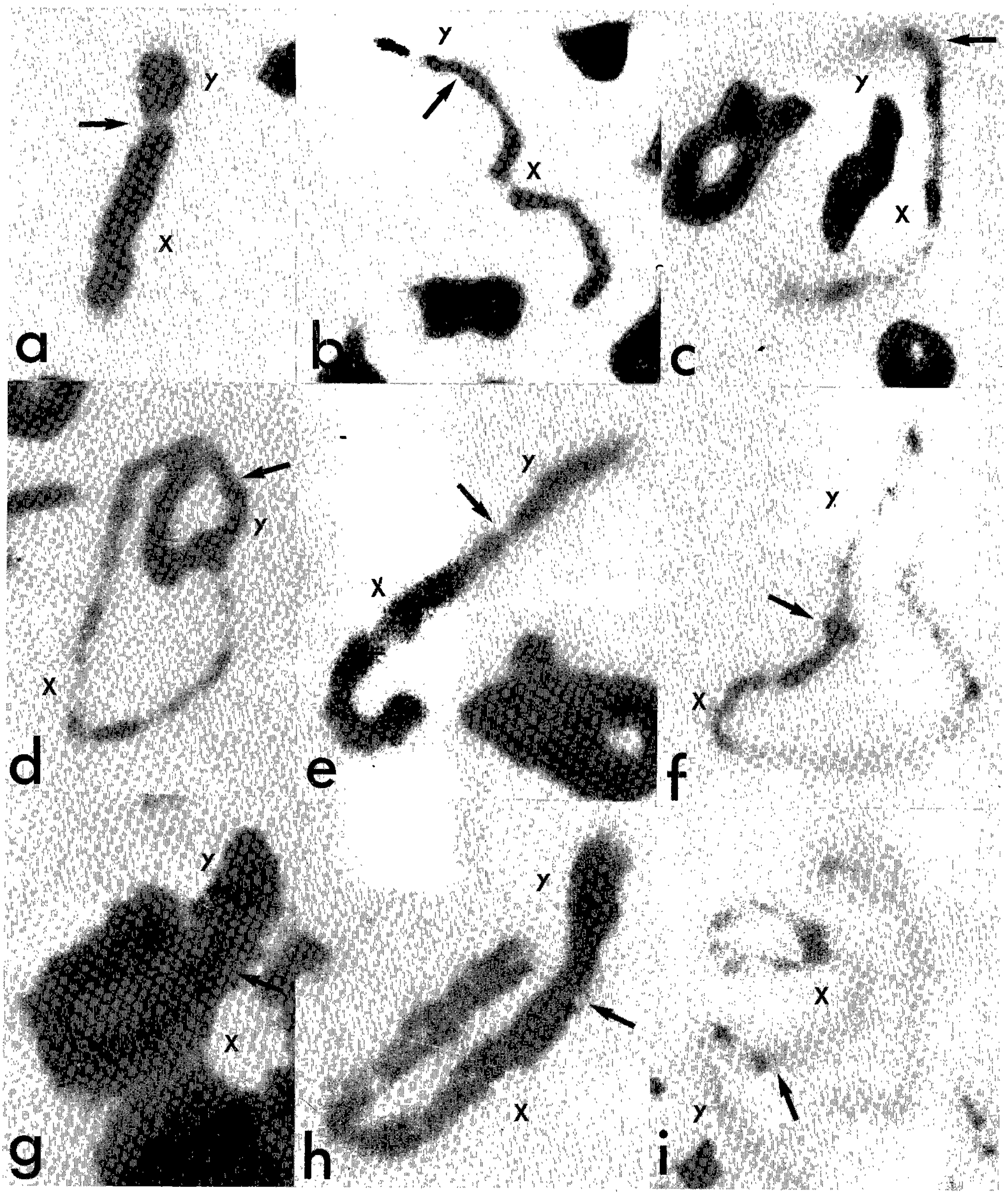


Photo 3. — a - i sex bivalents showing end to end association. The arrows (→) indicate the presumptive point of association betwen X and Y chromosomes.

probability furthers support that there is an end to end association between the XY chromosomes. Such dark band was not observed in meiotic chromosomes of *Bos taurus* (13).

The exact association of X and Y chromosomes in sex bivalent is controversial. BECAK *et al.* (1) reported 3 possible associations of X and Y chromosomes in mouse. In man, the short arm of X and long arm of Y are associated terminally (4). But CHEN and FALEK (2), PEARSON *et al.* (12), reported that short arm of Y is associated with homologus short arm of X in human meiotic chromosomes. REITALU (14) reported that XY association is not terminal but the medial part of long arm of Y chromosome is associated with distal part of short arm of X chromosome, as observed in human meiosis. PATHAK and ELDEN (11), in man meiotic preparations, could not indicate arms of the sex chromosomes involved in synopsis. However, in pachytene, when silver stained, they obtained hair pin-like band on the axis of X chromosomes in every Mammalian species examined by them, irrespective of size or morphology of X chromosome.

There is a positive correlation between chiasmata frequency and chromosome length. The average total number of chiasmata per cell was 58.24 which is almost similar to *Bos taurus* (16).

RENDEL (15) reported that crosses between Afrikander and *Bos taurus* do not have marked lower calving rates in F_2 because they have no difference in Y chromosome. Contrarily, crosses between *Bos taurus* and Brahman bulls in F_2 had low calving rates probably due to a translocation between Y and an autosome or between Y and X chromosome. In our meiotic preparations from all animals examined there is no cytological evidence of such a translocation so far.

In absence of any cytological evidence of translocation involving the Y chromosome, some other possibility could be assumed to explain the low fertility in F_2 generation of the crosses between *Bos indicus* and *Bos taurus* cattle. So, HALNAN (6) thinks that this low calving rate is due to negligible morphological differences between X chromosomes and even some autosomes carying the sex-determining genes, in *Bos indicus* and *Bos taurus*. These differences could modify the expression of some sex determining genes in crosses, which is responsible for the low fertility.

RESUMEN

SHARMA (A.), POPESCU (C. P.). Los cromósomos meioticos de los bovinos de raza Criolla de Guadalupe. *Rev. Elev. Méd. vét. Pays trop.*,1985, **38** (4) : 353-357.

Se estudiaron los cromósomos meioticos de los bovinos de raza Criolla en Guadalupe. Las células al estado de diaquinesis de los 8 toros fenotipicamente normales, de 18 meses de edad, mostraron 30 bivalentes con, por término medio, 58,24 quiasmatas por célula.

El bivalente sexual es el más grande y muestra una asociación de tipo uno detrás del otro entre los cromósomos X e Y. Se discuten diferentes hipotesis para explicar la tasa reducida de parto de los mestizos *Bos taurus* y *Bos indicus*.

Palabras claves : Bovino Criollo - Cromósomos - Guadalupe.

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