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A ROBERTSONIAN TRANSLOCATION AND FREEMARTIN CASES IN HYBRID FRIESIAN COWS RAISED IN EGYPT

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SUMMARY

Two cases of chromosomal abnormality were studied, one is a freemartin and the other is a translocation carrier. A new Robertsonian translocation was found in 1/2 Friesian cow. The fused chromosome analyzed by G-band technique resulted from the fusion of chromosomes 24/27. C-banding proved that the fused chromosome is dicentric. Aside the translocation, which presents in all the metaphases examined, chromatid gaps and breaks were rather high (6 and 6% , respectively). The freemartin had equal numbers of metaphase with XX and XY, and was found to have number (20 and 18%) of structural and numerical variation.

Keywords: Robertsonian translocation, freemartin, Friesian, hybrid

INTRODUCTION

Extensive variability was found in chromosome number, but very little in the number of chromosome arms was observed in the karyotype of several species of the Bovidae family (Wurster and Benrischke, 1968). Therefore, chromosome rearrangement, such as centric fusions, must be responsible for the interspecies variation. This type of chromosomal abnormality has been studied in cattle after discovery of the famous 1/29 translocation by Gustavsson and Rockborn (1964) in the

Swedish Red and White breed, Japanese Black cattle (Hanada et al, 1981), and some French breeds (Charolais, Montbeliard, Vosges) Popescu 1971, 1973 and 1976). In this work we describe a new centric fusion (Robertsonian translocation) observed in half Friesian cow breed.

A freemartin has been defined as a sexual imperfect (Swett et al., 1940), usually sterile, female partner of a pair of heterosexual twins. The Karyotype from leucocyte cultures in dizygotic twins showed sex chimerism (Ohno et al., 1962). The proportion of 60, XX & 60, XY cells varied between different individual freemartin and also between a freemartin and its cotwin.

The freemartin syndrome occurs in around 92% of bovine females born as a result of heterosexual twin pregnancies, and exists although at a much lower incidence, in sheep, pigs, goats and possibly other domestic animal species (Marcum, 1974).

MATERIALS AND METHODS

The material used in this work consists of two cases of cattle which collected from Western Farm of the Faculty of Agriculture, Cairo University, while Laboratory work and microscopic analysis were conducted at the cell Biology Dep. of the National Research Centre.

Blood cells were cultured for 72 h in 5 ml of T.C. 199 medium, 1 ml of serum and 0.1 ml of phytohaemagglutinin (PHA). Cells were treated with colchicine for 2 hs, then with a hypotonic (0.075 M KCl) for 20 min at 38°C. After fixation in acetic acid: ethanol (1:3) solution, the cell suspension was dropped on wet slides then flamed to dry. The chromosomes involved in the translocation were identified by G and C-banding. The C-bands were obtained by the BSG technique (Barium Hydroxide Saline/Giemsa) as described by Sumner (1972). The protocol of Seabright (1971) was used for G-banding.

RESULTS AND DISCUSSION

Cytological examination was carried out on two subfertile cows. Table (1) shows the chromosomal analysis of two cases of abnormalities (One robertsonian translocation carrier and a Freemartin case). The translocation carrier had a nearly metacentric chromosome in all the metaphases examined, while two

small acrocentrics were missed. Plate 1 shows a metaphase spread and karyotype of half Friesian cow carrying a Robertsonian translocation. According to the Reading conference, (Ford et al., 1976), the G-bands showed that the chromosomes number 24 and 27 are involved in this type of translocation (Plate 2). The two arms of the fused chromosomes have the same banding pattern as the free chromosomes number 24 and 27. In cells handled by C-banding method, the fused chromosome appears dicentric, because two blocks of constitutive heterochromatin are present in Plate 3. This 24/27 Robertsonian translocation, observed in the half Friesian cowbreed, is different from those previously described in cattle. Numerical aberrations were high, especially the peridiploid. Chromosome number 24 was reported in translocation with number 14 (Di Berardino et al., 1979). Chromosome number 27 was reported in translocation with number one by Eldridge (1975) and with 25 by De Giovanni et al. (1979) and with 21 by Berland et al. (1988). In addition to the translocation, there was a high number of chromatid gaps and breaks in this animal. The fact that the cow was subfertile is in agreement with the findings of some authors (Harvey 1971, Gustavsson 1969, 1971 and 1979 and Popescu 1984), who detected a decrease in fertility of heterozygous translocation carrier as compared to females with the normal karyotype.

The freemartin has an XX constitution in 50% of the examined metaphases, while the other 50% were XY.

Chromatid gaps and breaks were high, resulting in a very high number of structurally aberrant metaphases. Numerical aberrations were also high, especially polyploidy.

Although xx/xy chimaerism had been reported in cattle from a long time ago, there is still some new reports about some cases of freemartinism in cattle (Moreno et al., 1992). The reason of the incdence of xx/ xy chimaerism is due to the high twining rate in cattle compared with the buffalo and other Bovidae animals which produce a single fetus (Hendy and Bowman 1970).

It seems to be that the xx/ xy chimaerism is common in the family Bovidae, It is also reported in buffalo (Balakrishnan et al., 1981), sheep (Rynkiewicz-Szatkowska 1992), goat (El-Nahass et al., 1993) and red deer (Stewart- Scott et al ., 1990).

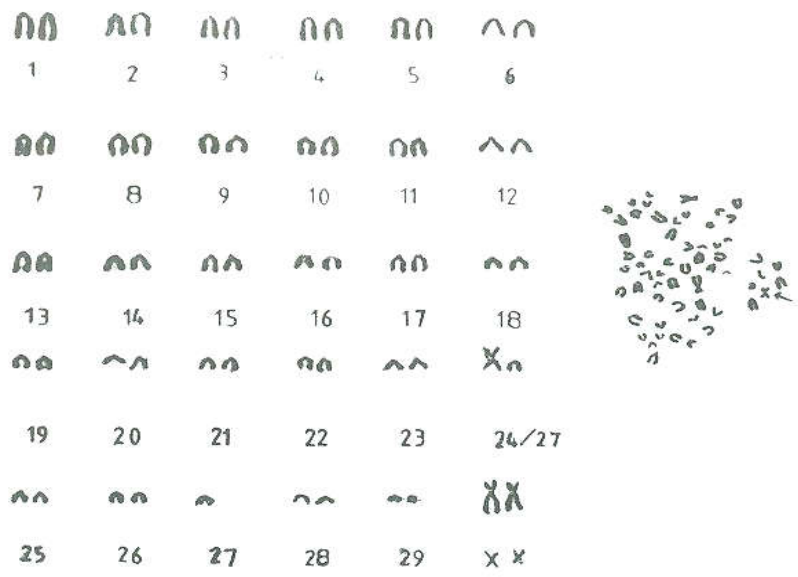

Plate 1 : Metaphase spread and karyotype of a half Friesian cow carrying a 24/27 Robertsonian translocation.

Plate 2 : Metaphase spread and G-banded karyotype of a half Friesian cow carrying a 24/27 Robertsonian trans-location

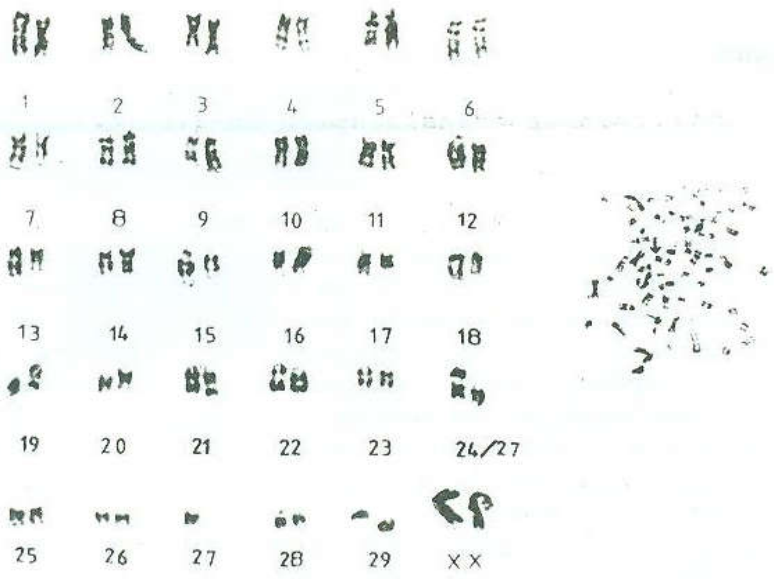

Plate 3 : Metaphase spread and C-banding cell showing two blocks of constitutive hetero-chromatin in the trans-located chromosomes.

Table (1): Chromosomal aberrations in abnormal cows

	No.of animals	no. of Exam Metaph.	Chro-matid gaps	Chro-matid breaks %	Chromo-somal gaps %	Chromo-somal Breaks %	Centric fusion %	MSA*	Peri-diploid %	Poly %
Robertsonian Translocation	1	50	6	6	--	4	100	100	100	8
Freemartin	1	50	8	8	2	--	2	20	8	10

* Metaphases with structural aberrations

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دراسة لحالتى إنتقال روبرتسون وأنثى توأميه شاذه فى النسل الناتج من تهجين أبقار الفريزيان

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تمت دراسة الإختلالات الكروموسومية لحالتين من هجن أبقار الفريزيان الأولى كانت عن أنثى توأميه شاذه بينما كانت الثانية أنثى حاملة لإنتقال روبرتسون. وجد بالنسبة للأنثى التواميه الشاذه تبرقش بين الخلايا الأنثوية والذكرية وكانت النسبة تقريبا متساوية كما وجد أيضا بعض أنواع الإختلالات الكروموسومية التركيبة بنسبة ٢٠٪ والعددية بنسبة ١٨٪ (أما فى حالة الإنتقال الروبرتسونى) فقد تم التعرف على نوع جديد من الإنتقال الروبرتسونية وهو ٢٧/٢٤ وقد تم تحديد أرقام الكروموسومات المشتركة فى الإنتقال بواسطة صبغة شريط الجيما (G - band) وكذلك أثبتت طريقة صبغة السنترمير (C - band) أن الإنتقال أو الألتحام تم بين الكروموسومين المشتركين فى منطقة السنترميد.