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Note

A new Robertsonian translocation in Holstein–Friesian cattle

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Summary – A new Robertsonian translocation was found in a cow of the Holstein–Friesian breed. GTG-banding allowed us to elucidate the anomaly as a centric fusion between chromosomes 19 and 21. CBG-banding demonstrated that the translocated chromosome was dicentric. Cytogenetic investigation of the relatives of the translocated animal revealed two other carriers.

cattle / Holstein–Friesian / chromosome / Robertsonian translocation

Résumé – Une nouvelle translocation robertsonienne dans la race Prim'Holstein. *Une nouvelle translocation robertsonienne a été mise en évidence chez une vache de race Holstein. La coloration en bandes GTG nous a permis d'identifier les chromosomes impliqués dans la translocation. Il s'agit des chromosomes 19 et 21. La coloration en bandes CBG montre que le chromosome transloqué est dicentrique. Une analyse cytogénétique des apparentés de l'animal porteur a permis de mettre en évidence deux autres animaux porteurs.*

bovin / Holstein / chromosome / translocation robertsonienne

INTRODUCTION

The first Robertsonian translocation described in cattle was the 1/29 translocation resulting from a centric fusion between chromosomes 1 and 29, with a single heterochromatic block (Gustavsson and Rockborn, 1964). Since that date, this anomaly has often been reported and occurs in many dairy and beef cattle breeds (Long, 1985). However, the 1/29 translocation has never been reported in the Holstein–Friesian breed. Up to now, only four types of Robertsonian translocations have been identified in the Holstein–Friesian breed: rob(13; 21), Kovacs et Papp,

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(1977); rob(14; 28), Ellsworth et al (1979); rob(1; 26), Miyake et Kaneda, (1987); and rob (1; 21), Miyake et al (1991).

The demonstrated or putative negative effect of the Robertsonian translocations on fertility (Long, 1985; Darré et al, 1990) incited some breeders to set up routine animal testing procedures. This allowed us to observe a new Robertsonian translocation in a 7-year-old (6th lactation) Holstein–Friesian cow. The translocated chromosomes analysed by GTG-banding resulted from the centric fusion of chromosomes 19 and 21. Twenty-five relatives of the translocated animal were karyotyped to determine the origin of the anomaly.

MATERIAL AND METHODS

Mitotic chromosomes were prepared from non-synchronized cultures of peripheral blood lymphocytes, or from synchronized cultures of skin fibroblast. Whole blood was cultured at 37°C for 72 h in RPMI 1640 medium supplemented with 20% fetal calf serum, 500 UI Heparin, 1% antibiotic–antimycotic solution (Gibco), and stimulated with Concanavalin A (final concentration: 0.3 µg/L). Colcemid (final concentration 0.03 µg/L) was added to the culture 60 min before harvesting. Primary fibroblast cultures were initiated from skin fragments, disrupted and digested in a trypsin solution (2.5 g/L), and grown at 37°C in a CO_2 incubator in Falcon dishes (75 cm^2) containing a medium comparable to that previously described for lymphocyte cultures (RPMI 1640 replaced by Ham's F12). Hypotonic treatment (10 mL 1/6 calf serum) was followed by pre-fixation and fixation in ethanol/acetic acid (3:1). Chromosome preparations were spread on cold wet slides and air dried. After overnight incubation at 60°C, the preparations were treated for GTG banding according to Seabright (1971), and for CBG staining according to Summer (1972).

Chromosomes were arranged according to the standard nomenclature, ISCNDA (1990).

RESULTS AND DISCUSSION

Giemsa staining of preparations revealed 59 chromosomes including a new metacentric chromosome similar in size to the X-chromosome (fig 1). GTG-banding allowed us to elucidate the anomaly as a centric fusion of chromosomes 19 and 21 (fig 2). CBG-banding showed that the translocated chromosome was dicentric (fig 3). This may suggest that the anomaly occurred recently (Eldridge, 1985).

Cytogenetic studies of relatives were carried out. The anomaly was found in two other animals of the same herd; an offspring and a maternal half-sister of the cow. All the carrier animals were phenotypically normal and appeared healthy. The presence of the translocation in one maternal half-sister seemed to indicate maternal origin of the anomaly. Unfortunately the dam had died. Investigations in the maternal grandam-offspring were carried out (N = 13) but all the animals demonstrated a normal karyotype. For diverse reasons, it was not possible to investigate the paternal side of the offspring and ancestors for this anomaly. The effects of this translocation on fertility have still not been analysed.

ACKNOWLEDGMENTS

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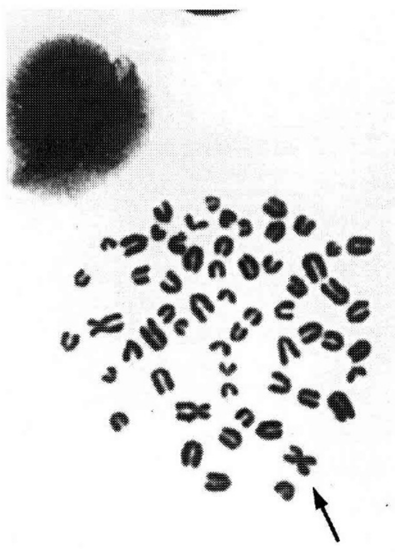

Fig 1. Giemsa-stained metaphase showing an unusual metacentric chromosome (arrow).

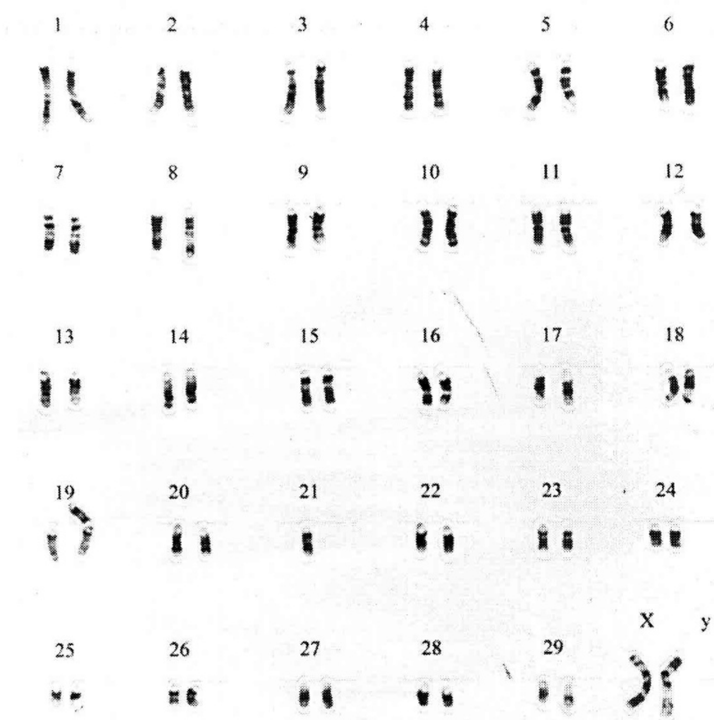

Fig 2. GTG-stained karyotype of the cow heterozygous for the 19/21 translocation.

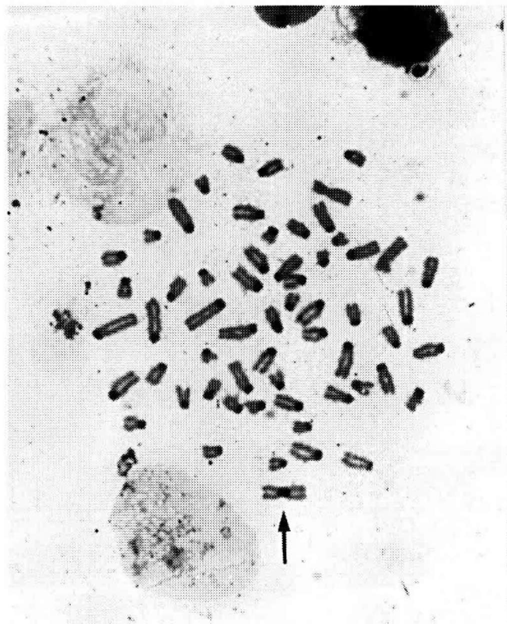

Fig 3. CBG-stained metaphase (the arrow shows the translocated chromosome).

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Corrigendum

In the article 'ECM approaches to heteroskedastic mixed models with constant variance ratios' by JL Foulley, *Genet Sel Evol* (1997), 29, 297-318, one should read Formula [11]:

$$\begin{bmatrix} \sum_{i=1}^{I} \mathbf{X}_i'\mathbf{X}_i/\boldsymbol{\sigma}_{e_i}^{2[t]} & \sum_{i=1}^{I} \mathbf{X}_i'\mathbf{Z}_i\tau^{[t]}/\boldsymbol{\sigma}_{e_i}^{[t]} \\ \sum_{i=1}^{I} \mathbf{Z}_i'\mathbf{X}_i\tau^{[t]}/\boldsymbol{\sigma}_{e_i}^{[t]} & \sum_{i=1}^{I} \mathbf{Z}_i'\mathbf{Z}_i\tau^{[t]2} + \mathbf{A}^{-1} \end{bmatrix} \begin{bmatrix} \widehat{\boldsymbol{\beta}}^{[t]} \\ \widehat{\mathbf{u}}^{*[t]} \end{bmatrix} = \begin{bmatrix} \sum_{i=1}^{I} \mathbf{X}_i'\mathbf{y}_i/\boldsymbol{\sigma}_{e_i}^{2[t]} \\ \sum_{i=1}^{I} \mathbf{Z}_i'\mathbf{y}_i\tau^{[t]}/\boldsymbol{\sigma}_{e_i}^{[t]} \end{bmatrix}$$

Appendix:

Derivatives with respect to $\boldsymbol{\delta}$

$$\frac{\partial(2Q)}{\partial\boldsymbol{\sigma}_{e_i}^2} = -\frac{n_i}{\boldsymbol{\sigma}_{e_i}^2} + \frac{\mathrm{E}_c(\mathbf{e}_i'\mathbf{e}_i)}{\boldsymbol{\sigma}_{e_i}^4} + \frac{\tau\,\mathrm{E}_c(\mathbf{u}^{*'}\mathbf{Z}_i'\mathbf{e}_i)}{\boldsymbol{\sigma}_{e_i}^3}$$

$$\frac{\partial(2Q)}{\partial\boldsymbol{\delta}\partial\boldsymbol{\delta}'} = -\sum_{i=1}^{I} w_{\delta\delta,ii}\mathbf{p}_i'\mathbf{p}_i = -\mathbf{P}'\mathbf{W}_{\delta\delta}\mathbf{P} \qquad \text{[A5a]}$$

Derivatives with respect to τ (ratio)

$$\frac{\partial\mathrm{E}_c(\mathbf{e}_i'\mathbf{e}_i)}{\partial\tau} = 2\mathrm{E}_c\left[\left(\frac{\partial\mathbf{e}_i'}{\partial\tau}\right)\mathbf{e}_i\right]$$