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A NEW ROBERTSONIAN TRANSLOCATION IN AN INTERSEX GOAT: MORPHOMETRIC DETERMINATION

UNA NUEVA TRANSLOCACION ROBERTSONIANA EN UNA CABRA INTERSEXO: DETERMINACION MORFOMETRICA.

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Summary

An intersex goat of Malagueña breed with a karyotype which is clearly different from that of the rest of the species as regards number and shape was studied. The karyotype was formed by 59 chromosomes all of them acrocentric with the exception of one large metacentric chromosome. The morphometric study of the latter showed us that it was the result of a robertsonian translocation between chromosomes of pairs 10 and 12.

Resumen

Se ha estudiado una cabra intersexo de la raza Malagueña con un cariotipo diferente del de la especie en cuanto a número y forma. Este se encontraba formado por 59 cromosomas, todos ellos acrocéntricos con la excepción de un gran cromosoma metacéntrico. El estudio morfométrico del mismo nos indicó ser el fruto de una translocación robertsoniana entre cromosomas de los pares 10 y 12.

Introduction

Since 1984 intersexuality in the Malagueña goat breed has been studied. This breed is located in the South-East of Spain and has as many horned as unhorned individuals. An intersex animal of this breed showed an unbalanced karyotype because of the presence of a large bi-armed chromosome, product of a translocation. In the present study we tried to determine the chromosomes involved, starting from a morphometric study of the chromosomes of the carrier animal.

Material and Methods

Cultures of whole blood were made following De Grouchy's modified method (1964) from an intersex goat two months old.

The metaphasic plates were photographed with 100X objetive on 18 DIN Ilford PAN-F film and printed on nº 2 photographic paper. The karyotypes were made up by ordering the chromosomes in decreasing sizes and measuring each chromosome as

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well as the two arms of the bi-armed chromosome. For this, a gauge with a precision of 0.05 mm. was used on enlargements of 10 times the negative.

The number of metaphasic plates studied was 100 out of which 30 were chosen for their contrast and the delimitation of chromosomic outlines for the setting up of the idiograms and measurement of their chromosomes.

Because of the different degrees of concentration of the chromosomes in the different metaphases, it was only possible to carry out an analysis of the chromosomic measurements, expressed as such per thousand of the total of the haploid complement, and not as real measurements. This transformation is calculated following the equation used by different authors (Gustavsson, 1969; Cribiu and Popescu, 1974):

$$RL_i = \frac{1.000 \times A_i}{\frac{\Sigma A_i}{2} + X}$$

in which
RL_i = Relative length of each chromosome.
A_i = Real length of each chromosome.
X = Mean real length of the X-chromosomes.

Starting from this transformation, for each chromosome and the arms of the extra-chromosome, its mean relative length, as well as the standard error, the typical deviation and the variation coefficient have been calculated.

In the same way, for the latter chromosome, the mean value of its centromeric index was also calculated according to the following equation (Levan *et al.*, 1964):

$$i = \frac{100 \times s}{c}$$

in which
i = Centromeric index.
s = Length of the short arm (p) of the chromosome.
c = Total length of the chromosome.

The ratio between the arms (r), which according to these is the ratio between the long arm (q) and the short arm (p) of the chromosome, was also calculated.

Finally, a t-distribution with 58 degrees of freedom was carried out between the mean relative lengths of each chromosomic arm of the extra chromosome and those of the chromosomes which preceded and followed in size respectivelly, according to the idiogram set up.

Results and Discussion

During a study on intersexuality in goats of the Malagueña breed (Moreno Millán and Rodero, 1988), we observed a female animal which showed a chromosomic complement of 59 chromosomes instead of the normal count of 60. We also observed the presence of a large biarmed chromosome different to the rest (figure. 1). On making a more profound study of

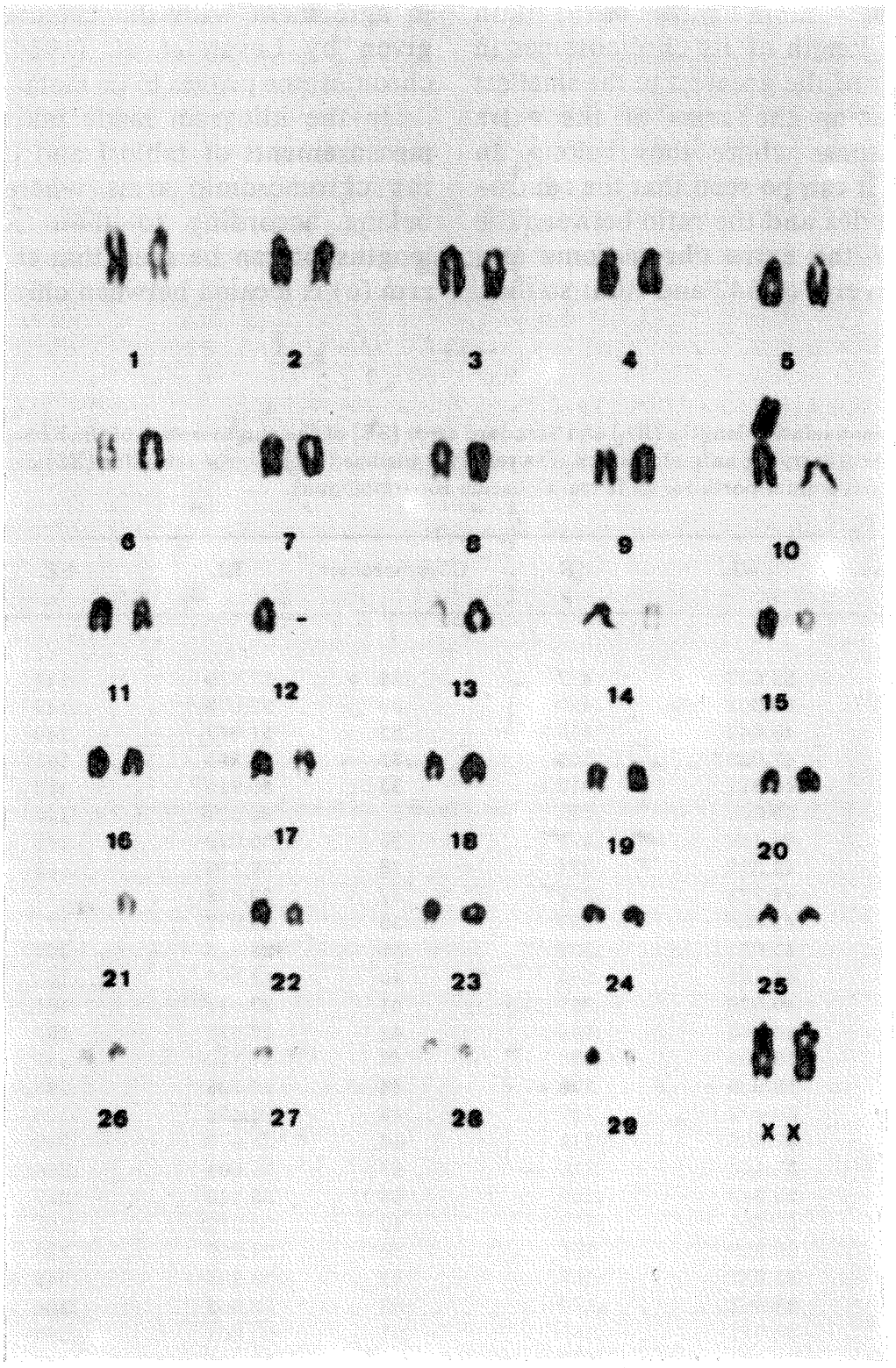

Figure 1. Karyotipe of the studied intersex goat. (Cariotipo de la cabra intersexo estudiada).

this animal, table I shows us the mean relative length of its chromosomes in an order of the greatest to the smallest and placing the arms of the extra chromosome where they belong. In table II it can be seen that the centromeric index and the ratio between the arms of the extra chromosome are, respectively, 48,547 and 1,061 so that, in agreement with the classification given by Levan *et al.* (1964), this chromosome proves to be metacentric.

In the idiogram made taking the measurements of table I and placing the chromosomic arms where they belong according to their relative lengths, it can be seen that the long arm (q) is located between chromoso-

Table I. Mean relative lengths (RL) and Standard error (SE) of the chromosomes of the Robertsonian translocation carrying animal. (Longitudes relativas medias (LR) y error estándar (ES) de los cromosomas del animal portador de la translocación robertsoniana).

Chromosomes	RL	SE	Chromosomes	RL	SE
1	52.617	.477	29	32.379	.148
2	50.303	.429	30	32.073	.145
X	48.441	.418	31	31.647	.140
X	47.085	.364	32	31.323	.141
3	46.311	.310	33	30.919	.153
4	45.082	.315	35	30.521	.143
5	44.149	.276	35	30.079	.143
6	43.323	.274	36	29.786	.153
7	42.781	.271	37	29.428	.161
8	42.306	.259	38	29.027	.177
9	41.623	.238	39	28.643	.157
10	41.131	.243	40	28.240	.161
11	40.629	.251	41	27.911	.161
12	40.065	.254	42	27.628	.183
13	39.409	.233	43	27.210	.186
14	38.939	.229	44	26.795	.193
15	38.472	.227	45	26.462	.194
16	37.896	.211	46	25.976	.240
17	37.444	.210	47	25.604	.264
18	36.843	.180	48	25.140	.257
19 (q)	36.351	.558	49	24.572	.248
20	36.229	.175	50	24.069	.256
21	35.537	.168	51	23.498	.245
22	34.961	.170	52	23.062	.264
23	34.511	.161	52	22.601	.260
24 (q)	34.381	.673	52	22.202	.249
25	34.060	.152	55	21.634	.289
26	33.659	.159	56	21.140	.307
27	33.225	.147	57	20.533	.319
28	32.747	.132	58	19.391	.400

Table II. Centromeric index (i) and Ratio (r) between the arms of the chromosome originated in the translocation present in the studied animal. Standard error (SE) of them and type of chromosome according to Levan et al. (1964). (Indice Centromérico (i) y Razón entre los Brazos (r) del cromosoma originado en la translocación presente en el animal portador. Error estándar (SE) y tipo de cromosoma según Levan et al. 1964).

		SE	TYPE
i	48.547	.223	METACENTRIC
r	1.061	.009	METACENTRIC

mes 18 and 20 and the short arm (p) between 23 and 25. Table III, shows us the result of the t-distribution between them from which it is observed that all are non-significant and the smallest differences are found between the long arm (q) and chromosome 20 and the short arm (p) and chromosome 23. On the evidence of these results it can be inferred that the chromosomes involved in the translocation were a chromosome of the pair 10 (which would give arm q) and another of the pair 12 (arm p).

In goats, and especially in the Saanen and Toggenburg breeds, many translocations of this type have been described, all of them causing submetacentric chromosomes. Popescu (1972), by relative measurements, identified a robertsonian translocation in the Saanen breed (trob 2/13) already cited previously by Padeh *et al.* (1965), Soller *et al.* (1966), Hulot (1969) and Padeh *et al.* (1971).

In 1973 Evans *et al.* described an autosomic translocation in a Saanen breed goat with a chromosomic complement of 59, XY. This translocation involved chromosomes of the pairs 5 and 15, producing a large submetacentric chromosome.

In the same breed, Elmiger and Stranzinger (1982) identified a new translocation of the same type which involved chromosomes of pairs 6 and 17. This translocation was studied by Dolf and Hediger (1984) by RBA banding and they came to the same conclusion. In a study published in 1987 by Burguete *et al.* a new translocation observed in Saanen goats in Italy was described involving chromosomes of the pairs 6 and 15. According to these authors, this centric

Table III. t-distribution between the arms (p and q) of the chromosome resulting from the translocation and the preceding and folloving chromosomes in decreasing size, according to Table I (DF = 58). (Pruebas t de igualdad de medias entre los brazos (p y q) del cromosoma resultado de la translocación y los cromosomas anterior y posterior en orden decreciente, según tabla I (GL = 58).

	18	20	23	25
	36.843	36.229	34.511	34.060
19(q) 36.351	1.268 ns	0.313 ns		
24 (q) 34.381			0.307 ns	0.760 ns

fusion is the same as the trob 6/17 studied by Elmiger and Stranzinger

(1982) and Dolf and Hediger (1984).

Dolf and Hediger reported in their paper the presence of a translocacion of this type in a male of the Toggenburg breed. This translocacion appeared to involve chromosomes of pairs 3 and 7, according to Burguete *et al.* (1987).

As we have been able to observe the robertsonian translocation, described up to now in goats have centred on the Saanen and Toggenburg breeds, possibly because the cytogenetic studies have mainly been centred on these breeds. We should emphasize that we have only noticed one translocation described in a goat of the Saanen breed with a hermaphrodite phenotype (Padeh *et al.*, 1965) and this, together with the translocation in a Malagueña goat described in this paper are the only two cases, as far as we know, to be found in the literature.

In view of this, we should go deeper into the cytogenetic investigations of goat populations with the aim of studying matters such as the incidence in the different breeds of translocations of this type, their origin and significance and in what way they influence the animal's reproductive capacity and livestock production.

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