THE IDENTIFICATION OF CHROMOSOME REARRANGEMENTS OF THE WILD AND DOMESTIC PIGS BY THE GIEMSA BANDING METHOD

Identification des reordinations chromosomiques chez le porc sauvage et domestique par la méthode des bandes de Giemsa

Identificación de las reordenaciones cromosómicas en el cerdo salvaje y en el doméstico por el método de las bandas de Giemsa

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Intraspecies chromosomal polymorphism has been established in wild boars (1, 2). It has been suggested that this polymorphism is due to centric or Robertsonian fusion of two acrocentrics into a single submetacentric (1, 3). The analysis of the cytogenetic features of sub-species of wild boars inhabiting the European and Asian regions of USSR is of interest in view of the fact that karyotype differentiation may be be applied to evolutionary, taxonomic and phylogenetic studies of pigs as well as other domestic animals (4).

This cytogenetic study concerns geographically very distinct populations of the wild boar representing following different sub-species inhabiting the territory of USSR: *Sus scrofa nigripes*, – 37 wild boars caught in Kirghiz SSR; *Sus scrofa ussuricus*, – 20 wild boars caught in the Far East and the Amur region; *Sus scrofa attila*, — 8 wild boars, killed in Azerbaijan SSR; *Sus scrofa ferus*, — 15 wild boars caugh in Lithuania and Bjelorussia.

For the analysis of methapase plates chromosome preparations were made from a culture of peripheral leucocytes with the addition of phytohaemagglutinin and colchicine (3). The preparations were treated with a 0.056 M hypotonic KCl solution. Differential staining was carried out by a somewhat modified technique of SEEBRIGHT (5) and EVANS *et al.* (6). The preparation were treated with a 0.3 % trypsin solution for 30-50 sec at 35 °C, washed and incubated in a fresh 2 × SSC solution for 1,5-2 hours at 56 °C; each slide was stained in buffered Giemsa at pH 6.8-7.0 for 5-10 min.

All the wild boars of the populations studied had a diploid number ranging from 36 to 38. Most boars of the Middle Asian and West European populations (35 boars) had a $2n = 36$, the other boars had 37 and 38 chromosomes in the

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karyotype. There were no individuals with a $2n = 36$ among the Far Eastern and Transcaucasian boars. The number of chromosome arms in all the karyotypes was constantly 64 (NF = 64). Differential stainning made possible the identification of all the homologous chromosomes of the karyotype.

Four chromosome groups may be tentatively distinguished in the karyotype of the wild boar: A) Large submetacentrics, B) Acrocentrics, C) Medium-sized submetacentrics, D) Metacentrics. Pair A 1: Short arms (*p*) have four dark bands and long arms (*q*) have eight dark bands. Pair A 2: *p* and *q* have a band each with a wide light zone visible at the proximal end of *q*. Pair A 3: *p* has a single dark band and *q* has two very close bands and a dark band in the centromere region. Pair A 4: *p* has a single darkband near the centromer, *q* has three bands. The cromosomes of pair 4 A are observed only in wild boars with 38 chromosomes as well as in all domestic pigs. Pair B 1 are the largest acrocentrics characterized by seven dark bands of different width; in case of pronounced chromosome coiling there may seem to be four bands. Pair B 2 has two bands at the proximal end of the arms and three bands at their distal end; between them distinguished a light zone with a very thin band. Pair B 3 consists of five dark bands evenly distributed along the chromosome arm. Pair 4 B shows three bands, two are nearer the centromere and the third one is located on the distal end. Pair B 5 possesses a wide band near the centromere and a thin band on the distal end. Pair B 6 has a clear-cut dark band on the distal end. All the chromosomes of groups C and D and the sex chromosomes also exhibit a peculiar banding pattern.

The comparison of karyotypes shows that the two domestic breeds studied, one of European origin (Landrace) and the other of Asian origin (Vietnamese Black), have a very similar banding pattern. Quite comparable karyotypes have been observed by HANSEN (7) and GUSTAVSSON *et al* (8), who have investigated mitotic chromosomes by means of techniques different from the one used in this study.

In pair A 4 the banding pattern of the short arm is identical with that of pair B 5, while the pattern of the long arm is identical with that of B 4. This gives grounds for assuming that submetacentric A 4 is the result of the translocation — centric fusion of acrocentrics B 4 and B 5. Wild boars with such karyotypes have been found among *Sus scrofa nigripes, Sus scrofa ussuricus* and *Sus scrofa attila.* Boars with a 37-chromosome karyotype from Middle Asian, Far Eastern and Transcaucasian populations are heterozygous for this translocation.

Karyotype analysis of *Sus scrofa ferus* (Lithuanian SSR) demonstrated karyotype similarity between the banding patterns of the short arm of A 4 and the banding patterns of the B 5, whereas the banding patterns of the long arm A 4 was found to be similar to that of B 3. Thus, it is the second way of formation of wild boars submetacentric chromosome A 4, which is never observed in karyotypes of domestic pigs. The high occurrence frequency of boars with these two translocations is indicative of their normal viability and fertility.

Thus, the differential staining of metaphase chromosomes and the maintenance of banding patterns made possible the localization of two types of interchromosomal translocation rearrangements in wild boars of different subspecies. The formation of morphologically different chromosomes in consequence of two types centric Robertsonian) fusions, which was observed in all the four populations

of wild boars, is noteworthy, if one takes into account that karyotypic polymorphism does not occur in domestic pigs of different origin. This is probably related to the fact that large chromosome number ($2n = 38$) increases the number of linkage groups of genes and thereby enhances combining variability in conditions of natural and artificial selection.

The data obtained characterize significant intraspecific divergence of wild boars from distinct geographic zones and give further grounds for referring the four subspecies studied to a single species — *Sus scrofa* L. The two types of formation of new submetacentrics from non-homologous acrocentrics in wild boars have broad genetic implications in that crosses between domestic pigs ($2n = 38$) and wild boars with different chromosomal rearrangements might help to clarify the genetic function of newly formed chromosomes and enable to use them as genetic markers.

SUMMARY

In the comparative study of the karyotypes of the 44 domestic pigs of the five different breeds (Vietnames Black, Siberan Omskaja Gray, Kakhethian-aborigen Georgian, Mangalica Hungarian, Landrace Swedish) and the 80 wild boars of the four subspecies (*Sus scrofa ussuricus* HEUDE, *S. s. nigripes* BLANF, *S. s. attila* THOS., *S. s. ferus* LINN.) by the Giemsa Banding Method revealed the two types of the chromosome rearrangements. The crosses between domestic pigs (2 n = 38) and wild boars (2 n = 36 and 37) with different chromosome rearrangements might help to clarify the genetic function of the chromosomes A 4, B 3, B 4, B 5 and enable to use them as genetic markers.

RESUME

Au cours de l'étude comparative des caryotypes de 44 porcs domestiques de cinq races différentes (Vietname Black, Siberian Omskaja Gray, Kakhethian-aborigen Georgian, Mangalicza Hungarian, Landrace Swedish), et de 80 sangliers mâles de quatre sous-espèces (*Sus scrofa ussuricus* HEUDE, S. s. nigripes BLANF, *S. s. attila* THOS, *S. s.* ferus LINN.), réalisée par la méthode des bandes de Giemsa, on découvrit deux types de réordinations chromosomiques. Les croisements entre le porc domestique ($2n = 38$) et le sauvage ($2n = 36$ et 37), avec de différentes réordinations chromosomiques, pourraient aider à rendre plus claire la fonction génétique des chromosomes A 4, B 3, B 4 et B 5, et à les utiliser comme marqueurs génétiques.

RESUMEN

En el estudio comparativo de los cariotipos de 44 cerdos domésticos de cinco razas diferentes (Vietnamese Black, Siberian Omskaja Gray, Kakhethian-aborigen Georgian, Mangalicza Hungarian, Landrace Swedish) y de 80 jabalíes machos de cuatro subespecies (*Sus scrofa ussuricus* HEUDE, *S. s. nigripes* BLANF, *S. s. Attila* THOS., *S. s. ferus* LINN.) por el método de las bandas de Giemsa, se revelaron dos

tipos de reordinaciones cromosómicas. Los cruces entre el cerdo doméstico ($2n = 38$) y del salvaje ($2n = 36$ y 37), con diferentes reordinaciones cromosómicas, podrían ayudar a clarificar la función genética de los cromosomas A 4, B 3, B 4 y B 5 y utilizarlos como marcadores genéticos.

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