

**POSSIBLE RELATIONSHIPS AMONG THE NUCLEOLUS
ORGANIZER REGIONS OF THE SPECIES *Tayassu
albirostris*, *Sus scrofa scrofa*, AND *Sus scrofa***

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ABSTRACT

Chromosome preparations of the species *Tayassu albirostris* (white-lipped peccary), obtained by a modification of the technique for human leukocyte culture, were studied. Chromosome banding patterns were obtained by silver staining and the chromosomes were arranged following the classification proposed by Giannoni and Ferrari (Ciênc. Cult. 28: 432-435, 1976).

Chromosome pairs numbers 4 and 10 were shown to be responsible for nucleolus formation in the species *Tayassu albirostris*. This result was discussed in terms of Ag-I banding patterns previously obtained for the chromosomes of *Sus scrofa scrofa* (wild boar) and *Sus scrofa* (domestic pig).

INTRODUCTION

The species *Tayassu albirostris* was first investigated cytogenetically by Giannoni (1972), who established the diploid chromosome number at 26 and arranged the chromosome by a personal classification. Hufty *et al.* (1973)

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compared the G-banding patterns of the chromosome of *Tayassu tajacu* and *Tayassu albirostris*, finding banding homology between several chromosomes. In a study of the karyotypic evolution of the family Suidae, Giannoni and Ferrari (1976 c,d,e,f,g) analyzed in detail the chromosomes of peccaries, comparing them with those of other species in the genera *Tayassu* and *Sus*. Giannoni (1979) advanced the hypothesis that pair number 14 of the domestic pig (classified as pair number 10 by the Reading Conference, 1980) and number 10 of the peccary, and the corresponding wild boar pair, identified as number 14 in Group E (classified as pair number 11 by the Reading Conference, 1980), have remained practically unchanged throughout the evolution from a "common ancestor". Hannah (1951) has reported that several nucleolus organizing chromosomes exist in most plant and animal organisms, with only two or one appearing in a smaller number of cases. In man, although 5 pairs of acrocentric chromosomes have nucleolus organizing regions, not all of them are associated during prophase. A common occurrence is to find 2 to 8 of these chromosomes in satellite associations.

The nucleolus organizing chromosomes can lose this function when involved in centric fusion. In this case, if a species has more than one pair responsible for nucleolus formation, one of the pairs will take on this function even though the other loses it. In the species where only one chromosome pair is responsible for nucleolus formation, biological difficulties may arise if this chromosome pair suffers abrupt structural alterations such as translocation, deletions and others. Therefore, karyotype selection should occur in such a way that the nucleolus organizing chromosomes will have a structure resistant to alterations. When the chromosomes of the subspecies *Sus scrofa* and *Sus scrofa scrofa* were submitted to silver-banding by Giannoni (1979), chromosome number 14 was the only one to be deeply stained throughout the large secondary constriction located between the centromeres and short arms. It is quite likely that pair number 14 in these subspecies and number 10 in the *Tayassu albirostris* species have not only remained intact throughout evolution from a "common ancestor", but are also undergoing a karyotype selection aiming at the formation of an architecture capable of withstanding most structural alterations.

The objective of this study was to determine the chromosome pair(s) responsible for nucleolus organization in the species *Tayassu albirostris* and to compare them with the corresponding chromosomes in the subspecies *Sus scrofa scrofa* and *Sus scrofa*.

MATERIAL AND METHODS

The species *Tayassu albirostris* (white-lipped peccary), *Sus scrofa scrofa* (wild boar) and *Sus scrofa* (domestic pig) were analyzed. Two pairs of animals were used for each species. Metaphases were obtained by the technique of Moorhead *et al.* (1960) using TC-199 medium. Twenty-five metaphase preparations were examined for each animal, and the chromosomes were arranged according to the classification proposed by Giannoni and Ferrari (1976c). Silver-banding was carried out by the method of Goodpasture and Bloom (1975).

RESULTS AND DISCUSSION

The chromosomes of a male and female white-lipped peccary showing silver banding are presented in Figure 1 and 2, respectively. The Figures show that chromosome pairs number 4 and 10 are responsible for nucleolus organization in *Tayassu albirostris*. The chromosomes making up pair number 10 have similar morphological characteristics and size (Giannoni, 1979; Giannoni and Ferrari, 1976c) and seem to play a role similar to that of chromosomes making up pair number 14 in the subspecies *Sus scrofa* and *Sus scrofa scrofa* (Figures 3 and 4). This strengthens the idea that in the species where one or two chromosome pairs are responsible for nucleolus organization, karyotype selection "seeks" to endow these chromosomes with an adequate structure to withstand structural alterations. Thus it seems that the chromosomes in pair number 10 of *Tayassu albirostris* have remained relatively intact throughout evolution from a "primitive ancestor", the same occurring with pair number 14 in the domestic pig and wild boar.

When examining the karyotype of the species *Sus scrofa*, McConnel (1963) observed that some animals, in addition to displaying the secondary constrictions typical of the chromosomes in pair number 14 also exhibited this characteristic in the chromosomes in pair number 9. Haag and Nizza (1969) attempted to establish whether these constrictions were sex-linked, obtaining negative results.

Giannoni (1979), after analyzing the distribution of this feature in a sample of 29 swine, found that 37.9% of the animals showed no constriction in chromosome pair number 9, 6.9% showed constriction in one of the chromosomes of pair number 9 and 55.17% showed constriction in both components of pair number 9. On the basis of these results, it was concluded that

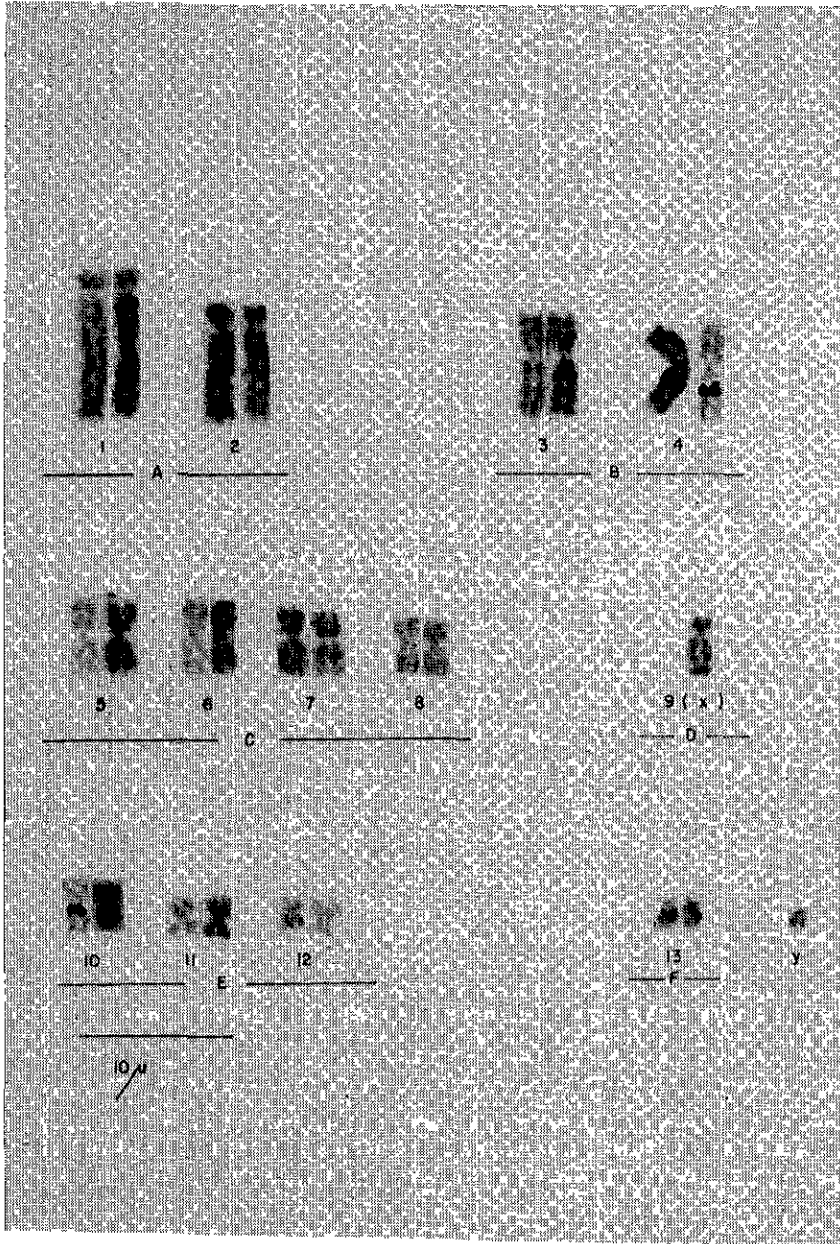


Figure 1 - Male white-lipped peccary. $2n = 26$. (Ag bands).

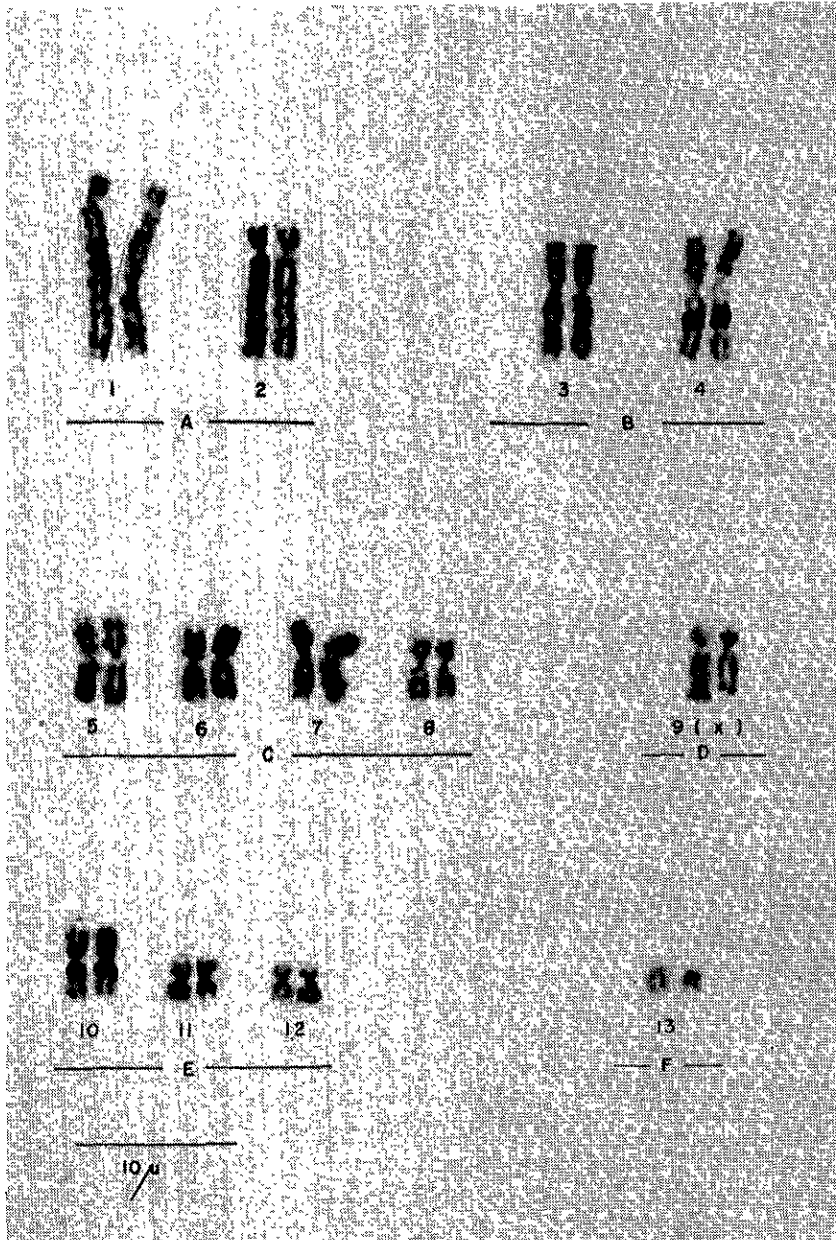


Figure 2 - Female white-lipped peccary. 2n = 26 (Ag bands).

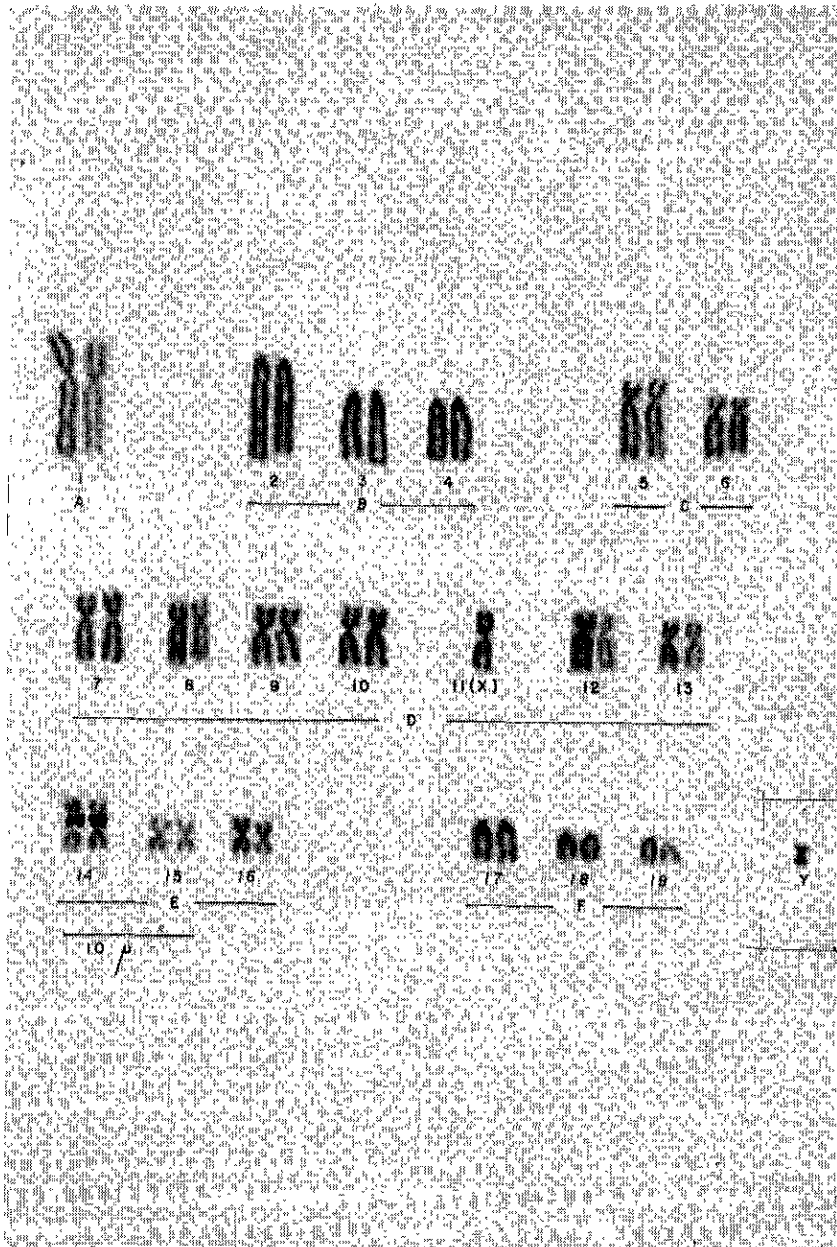


Figure 3 - Male domestic pig, $2n = 38$. (Ag bands).

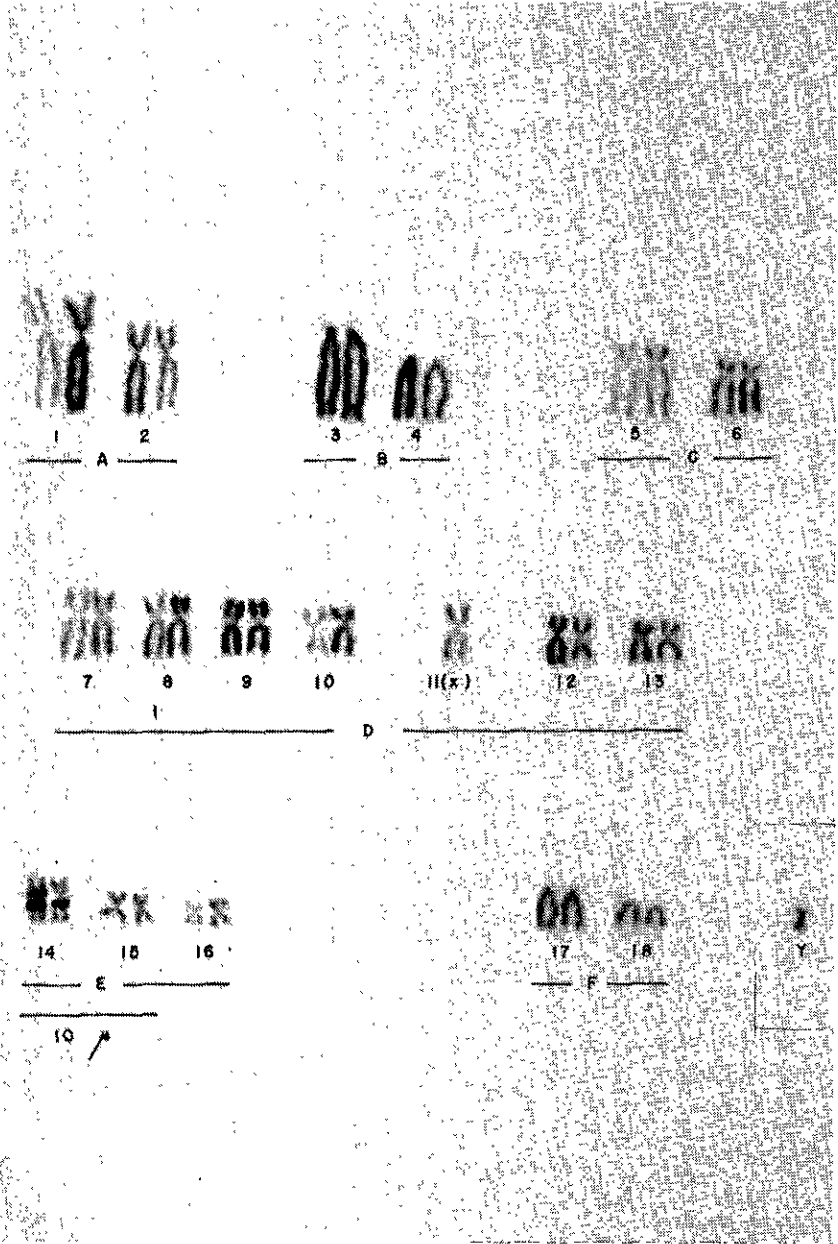


Figure 4 - Male wild boar. 2n = 36. (Ag bands).

polymorphism exists among the swine population in terms of this trait. Lin *et al.* (1980), using silver staining techniques, observed that chromosome pairs number 10 and 11 were responsible for nucleolus organization in the species *Sus scrofa*. They observed that no more than three chromosomes appeared to be stained by silver in any of the metaphases analyzed. This fact led them to conclude that only three chromosomes have nucleolus organizer regions (NOR) in domestic swine, and at least one of the components of pair number 10 is always present among them. The results obtained by these investigators may have been due to the swine sample analyzed, in view of the polymorphism described by Giannoni (1979). If the presence of secondary constrictions in chromosome pair number 9 indicates the existence of nucleolus organizer regions, it is possible that Lin *et al.* (1980) worked with a sample in which all individuals had no constrictions or only one constriction in the chromosomes of pair number 9.

In a study on *Sus scrofa* and *Sus scrofa scrofa* supporting this hypothesis, Giannoni (1979) observed silver staining only in the chromosomes making up one pair: number 14 in the pig and in the wild boar.

In the white-lipped peccary, in addition to silver staining in pair number 10 (which seems to correspond to the nucleolus organizer pairs in pigs and wild boars) Ag-I bands were also observed in pair number 4 of group B. Giannoni (1979) concluded that the species and subspecies in the genus *Tayassu* and *Sus* had a common ancestor which produced two evolutionary lines, one in Europe and Asia and the other in the Americas. In view of the results reported here, it is possible that this "common ancestor" had two or more chromosome pairs carrying nucleolus organizer regions which progressively disappeared by some special mechanism, with two remaining in some domestic pigs and wild boars.

In the white-lipped peccary, the nucleolus organizer region of chromosome pair number 4 is located in the upper third of the long arm. Therefore, if a common origin of the *Sus* and *Tayassu* species is postulated, mechanisms altering the positions of the nucleolus organizer regions in the chromosomes must have occurred.

RESUMO

Foram analisadas metáfases da espécie *Tayassu albirostris* (Queixada), obtidas por variação da técnica proposta por Moorhead *et al.* (1960) para a cultura de leucócitos humanos. Os padrões de formação de bandas pela prata foram conseguidos empregando-

se o método indicado por Goodpasture e Bloom (1975) e os cromossomos foram ordenados segundo a classificação proposta por Giannoni e Ferrari (1976c).

Foi determinado que os pares cromossômicos de números 4 e 10 são os responsáveis pela formação de nucléolos na espécie *Tayassu albirostris*. Este resultado foi discutido frente aos padrões de formação de bandas AG-I dos cromossomos das subespécies *Sus scrofa scrofa* (Javali) e *Sus scrofa* (suíno doméstico) obtidos por Giannoni (1979) e Lin *et al.* (1980).

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