Brazilian Journal of Genetics, 19, 2, 271-274 (1996)
(Revista Brasileira de Genética)

SHORT COMMUNICATION:

Chromosomal analysis of *Roeboides paranensis* (Pisces, Characidae) from the Paraná River

Isabel Cristina Martins-Santos and Mara Garcia Tavares

ABSTRACT

A cytogenetic study of *Roeboides paranensis* from the Paraná River showed a diploid number equal to 52 chromosomes, with a basic karyotype consisting of two metacentric pairs, 10 submetacentric pairs, four subtelocentric pairs and 10 acrocentric pairs (FN = 84). The NORs were located in the terminal position on the short arms of the third chromosome pair in the complement. Heterochromatin was found to be mostly centromeric and telomeric, with some interstitial blocks.

INTRODUCTION

According to Britski *et al.* (1986), the family Characidae is the most complex group among the Characiformes, and the one comprising the largest number of species, with about 30 subfamilies and 250 genera distributed throughout South America. Cytogenetic studies on the Characidae were first conducted by Post (cited in Almeida Toledo, 1978) and later Oliveira *et al.* (1988) catalogued 200 species, with haploid and/or diploid numbers, showing a chromosome number diversity ranging from 2n = 28 in a species of *Hemigrammus* (Scheel, 1973) to 2n = 64 in *Serrasalmus hollandi* (Muramoto *et al.*, 1968), with a predominance of 2n = 50 to 2n = 54 chromosomes. These data indicate a divergent karyotype evolution for this family. However, the Characidae subgroups do not show a single line of evolution, as is the case for the Tetragonopterinae, with a wide variation in the diploid number (Falcão and Bertollo, 1985), and the Salmininae with very uniform karyotypes (Foresti, 1976).

Departamento de Biologia Celular e Genética e NUPELIA, Universidade Estadual de Maringá, 87020-900 Maringá, PR, Brasil. Send correspondence to I.C.M.-S.

The Characidae includes several subfamilies. One of them is the Characinae, which contains the genus *Roeboides*, with 16 species that have not been studied cytogenetically. The only data available for the subfamily Characinae refer to the haploid number of *Exodon paradoxus* (n = 26, Scheel, 1973), indicating a diploid number equal to 52.

MATERIAL AND METHODS

Karyotypic studies were carried out on 10 individuals (five males and five females) of *Roeboides paranensis* (Characinae) collected from the Paraná River, Porto Rico Region in the State of Paraná. Mitotic chromosomes were obtained from kidney cells by the drying technique described by Bertollo *et al.* (1978). The nuclear organizer regions were identified by the silver staining technique of Howell and Black (1980) and the constitutive heterochromatin segments were visualized by the C-banding technique of Sumner (1972). The karyotypes were arranged in decreasing order of size, with the chromosomes grouped into metacentrics,

submetacentrics, subtelocentrics and acrocentrics, according to the criterion of Levan *et al.* (1964).

RESULTS AND DISCUSSION

Analysis of the karyotypes of *R. paranensis* demonstrated a diploid number of 2n = 52 chromosomes with two metacentric pairs, 10 submetacentric pairs, four subtelocentric pairs, 10 acrocentric pairs and a total chromosome arm number (FN) equal to 84 (Figure 1). Comparison of male and female karyotypes of *R. paranensis* showed no sex chromosome heteromorphism. Morphologically distinguishable sex chromosomes among Characidae have been observed only in some species of the Triportheinae (Falcão, 1988; Bertollo and Cavallaro,1992) and probably in Cheirodontinae (Wasko and Galetti Jr., 1994), all of them with a ZZ/ZW chromosome mechanism.

Ohno *et al.* (1969) assumes that the primitive karyotype of teleosteans consisted of 48 acrocentric chromosomes, with FN = 48. On this basis, the large number of acrocentric chromosomes in *R. paranensis* (Figure 1) suggests primitive stage of karyotypic diversification, when compared with other Characidae groups such as Colossoma and Bryconinae, where such chromosomes are not observed. Nevertheless, it has also been proposed that the ancestral karyotype for characids includes 2n = 50 chromosomes M-SM, particularly for the subfamily Tetragonopterinae (Portela et *al.*, 1988). This assumption is based on the chromosome analysis of two species of the genus Moenkhausia having the same karyotype. However, the karyotype of *M. pitteri* (2n = 50) showed the presence of only 12-14 bi-armed chromosomes while the others are subtelo- and acrocentric (Arefjev, 1989), indicating a heterogenous karyotype for *Moenkhausia* species. The lack of data concerning the degree of primitiveness of this genus does not permit us to prove that an entirely symmetrical karyotype is ancestral for the Characidae (Arefjev, 1990).

Scheel (cited in Kirby *et al.*, 1977) showed that the first pair in the karyotype of several species of Characidae consists of a large metacentric. Figure 1 clearly shows that *R. paranensis* does not fit this situation. Indeed, the first metacentric pair in this species does not stand out from the rest of the complement and the largest chromosomes in the karyotype (pairs 3, 13 and 17) are not metacentric. Variation in the size of this pair in relation to the remaining chromosomes in the karyotype was observed in *Tetragonopterus chalceus*, *Piabina argentea* and *Bryconamericus stramineus*. In these species, there was no large difference in size between this pair and chromosome pairs 2 and 3, though the first pair still was the largest in the complement (Portela *et al.*, 1988). According to these authors and Morelli *et al.* (1983), this chromosome may be undergoing a loss of chromatin material during evolution.

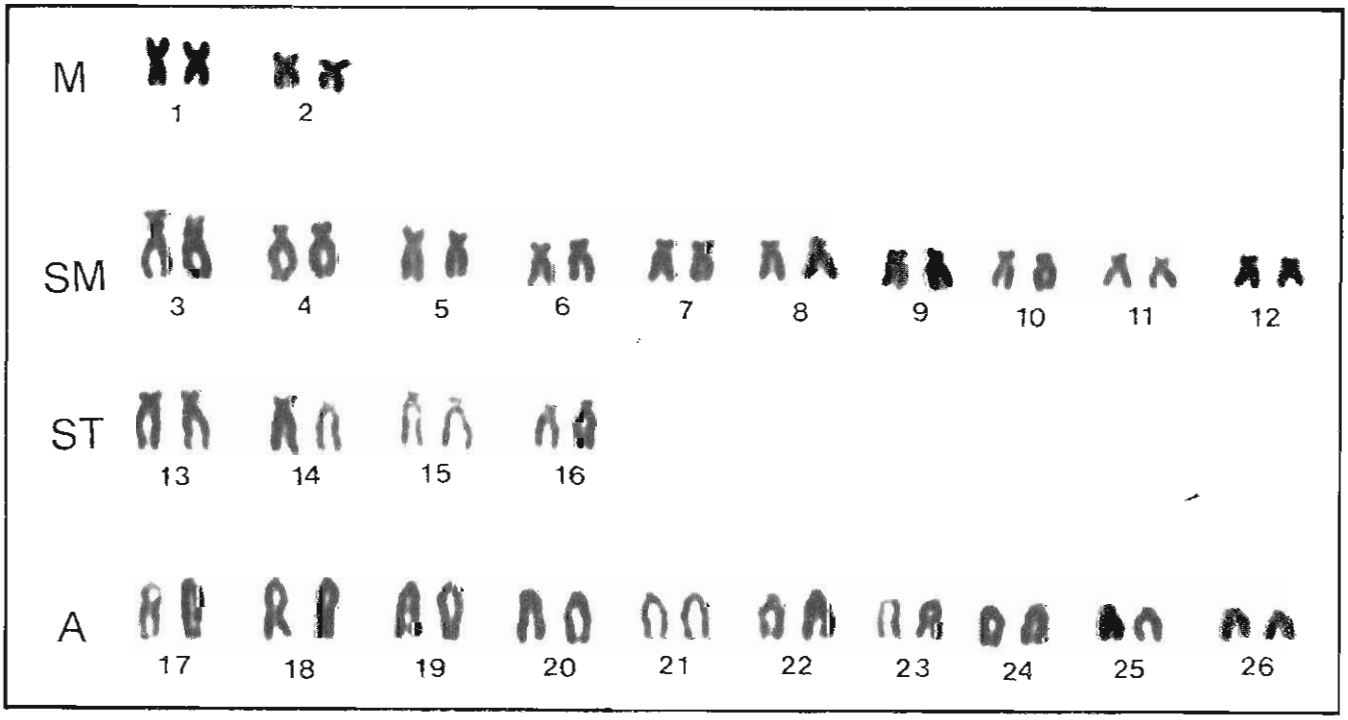

Figure 1 - Karyotype of *Roeboides paranensis*. X1,000.

Figure 2 - Sequential analysis with conventional Giemsa staining (A) and NOR-banding (B) of *Roeboides paranensis*. X1,000.

Most Characidae species show a multiple NOR system. However, our data show that *R. paranensis* has a simple NOR located on the short arm of the third pair in the complement, coinciding with a secondary constriction which is more evident in one of the NOR-bearing homologue (Figure 2). Most fish species analyzed by the silver staining technique have shown a variation in NOR size between homologous chromosomes. This heteromorphism is probably due to the tandem duplication in one of the NORs (Almeida-Toledo and Foresti, 1985). Thus, inter- and intraindividual variation in NOR size occurs, reflecting a different number of ribosomal cistrons or a differential activity of the homologue. Some authors consider the simple NORs as a more primitive condition in comparison with the multiple ones (Hsu *et al.*,1975). So, this strengthens the hypothesis that *R. paranensis* presents primitive characteristics in terms of karyotype diversification, compared to the other Characidae. On the other hand, this species presents the general pattern of constitutive heterochromatin distribution of the family, with centromeric, telomeric or interstitial marks distributed among the various chromosomes (Figure 3). A NOR-positive C-band was also observed. However, better comparisons of intra- and intergenus C-banding patterns cannot be performed due to the lack of cytogenetic data.

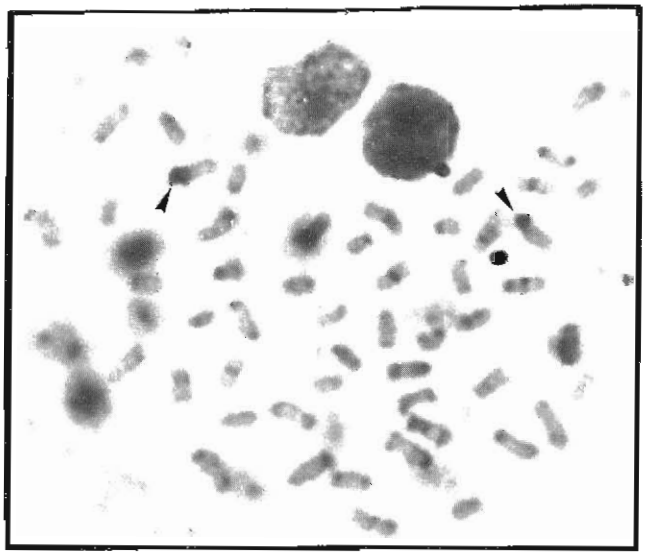

Figure 3 - C-banded metaphase of *Roeboides paranensis*. The arrowheads indicate NOR-positive C-bands. X1,000.

ACKNOWLEDGMENTS

Financial support by CNPq and Universidade Estadual de Maringá is gratefully acknowledged.

RESUMO

Análise citogenética de *Roeboides paranensis* do rio Paraná mostrou um número diplóide igual a 52 cromossomos, com um cariótipo básico consistindo de dois pares de cromossomos metacêntricos, 10 pares de submetacêntricos, quatro pares de subtelocêntricos e 10 pares de acrocêntricos (NF = 84). A NOR está localizada no braço curto do terceiro par do complemento cromossômico. A heterocromatina constitutiva mostrou-se preferencialmente centromérica, com alguns blocos intersticiais.

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(Received May 2, 1995)