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Short Communication

Cytogenetics of ten ant species of the tribe Attini (Hymenoptera, Formicidae) in Barro Colorado Island, Panama

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Abstract. We examined karyotypes of 10 attine ant species of six genera collected from Barro Colorado Island, Panama. The karyotypic data are as follows ; *Atta colombica* (n=11, 2n=22 ; 18 M+4A), *Sericomyrmex amabalis* (2n=50 ; 50 M), *Trachymyrmex septentrionalis* (n=10, 2n=20 ; 20 M), *T.* sp. 1 (n=6, 2n=12 ; 12 M), *T.* sp. 2 (2n=18 ; 18 M), *Cyphomyrmex rimosus* (2n=32 ; 28 ?M+4 ?A), *C. costatus* (2n=20 ; 20 M), *Apterostigma mayri* (2n=24 ; 24 M), *Ap.* sp. (2n=24 ; 24 M), and *Mycocepurus* sp. (2n=8 ; 8 M). C-bands are localized at centromeric region in all chromosomes in *C. costatus* and *Ap. mayri*, while *At. colombica*, *S. amabalis* and *T.* sp. 1 carry additional interstitial C bands in 4, 10 and 4 chromosomes, respectively, suggesting the occurrence of tandem fusion in these chromosomes.

Keywords : Attine ants, Higher attines, Lower attines, Karyotypes, C-bands

Introduction

The tribe Attini is distributed only in the New World from southern United States to central Argentine. These ants are interesting organisms because they cultivate fungus gardens upon which they depend for nourishment. Currently Attini are divided into 11 genera comprising 203 species, with approximately 85 additional subspecies and varieties (Kempf, 1972 ; Schultz and Meier, 1995). The phylogeny of this ant tribe already has shown in detail using 16S-like RNA and 28S ribosomal DNA of symbiotic fungi (Chapela *et al.*, 1994 ; Hinkle *et al.*, 1994 ; Mueller *et al.*, 1998), morphology of ant larvae (Schultz and Meier, 1995) and mtDNA sequence of ant pupae (Wetterer *et al.*, 1998). Chromosomal data of this tribe are not provided to the phylogeny or the karyotype evolution because of the paucity of the karyotype analysis. Although more than 500 ant species have been studied on their karyotypes (Hauschteck-Jungen and Jungen, 1983 ; Imai *et al.*, 1984 ; Imai *et al.*, 1988), only seven species (three genera) of the tribe Attini have been reported (Goñi *et al.*, 1983 ; Fadini and Pompolo, 1996).

The present communication provides karyotypic data on 10 additional species, belonging to 6 genera of tribe Attini including lower and higher genera (North *et al.*, 1997) and is the first report of C-banded karyotypes of attine ants.

Materials and methods

The following 10 species of attine ants, collected on Barro Colorado Island, Panama (7°10′N, 79°57′E) in 1996 were studied. Five species of 3 genera in higher attine ants : *Atta colombica* 15 workers and 3 males from 5 colonies ; *Sericomyrmex amabalis* 5 workers from 3 colonies ; *Trachymyrmex septentrionalis* 5 workers and 3 males from 3 colonies ; *T.* sp. 1 10 workers and 5 males from 4 colonies ; and *T.* sp. 2 3 workers and 2 queens from 2 colonies. Five species of 3 genera of lower attine ants : *Cyphomyrmex rimosus* 5 workers from 5 colonies ; *C. costatus* 3 workers from 3 colonies ; *Apterostigma mayri* 5 workers from 5 colonies ; *Apterostigma* sp. 4 workers from 4 colonies ; and *Mycocepurus* sp. 2 workers from one colony.

Air-dried chromosomal preparations were made using cerebral ganglia of prepupa by following techniques

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described by Imai *et al.* (1988) with minor modifications, and stained with Giemsa. C-bands were induced by the method described by Sumner (1972). Chromosomes were arranged the following order of metacentrics, submetacentrics, subtelocentrics and acrocentrics, with decreasing in size.

Results and discussion

The results of chromosome analysis of Attini are summarized in Table 1.

In higher attine ants, we examined five species of three genera. As shown in Fig. 1 and Table 1, the chromosome numbers of each species showed a high variation with 2n=12 to 2n=50. Among them, *S. amabalis* had the highest chromosome number of 2n=50. Karyotype analysis exhibited that only *Atta colombica* had acrocentric chromosomes (two pairs), while other species carried all meta- or submetacentrics. Although *S. amabalis* had the highest chromosome number in this tribe, its karyotype contained only biarmed and no acrocentric chromosomes, suggesting that the high number of chromosomes of this species has not been proceeded through centric fission.

In lower attine ants, five species of three genera were examined. The chromosome numbers of these species ranged from 2n=8 to 2n=32 (Table 1). As shown in Fig. 2, only *C. rimosus* had acrocentric chromosomes, while the karyotype of the other species contains only meta- or submetacentrics. Although the contracted chromosome preparations from the *C. rimosus* do not allow the exact number of acrocentrics in the karyotype, at least two pairs of acrocentrics are countable.

The C-bands in five species in both higher and lower attine ants are localized around the centromere in all chromosomes. Three species of *At. colombica* (2n=22), *S. amabalis* (2n=50, Fig. 3A) and *T.* sp. 1 (2n=12, Fig. 3B) had additional interstitial C-bands in 4, 10 and 4 chromosomes in their diploid karyotypes, respectively. It would appear from these results that the occurrence of tandem fusion rather than inversion may be a mechanism of karyotypic evolution in these species, since centromeric C-bands in similar size have been commonly found in these genera.

In the karyotype evolution of ants the direction of chromosome alteration has been considered to be metacentric → submetacentric → telocentric → acrocentric through chromosomal mutations such as Robertsonian rearrangements, pericentric inversion, tandem growth of constitutive heterochromatin, and so forth (Imai *et al.*, 1986, 1988). However, our C-banding analyses in the present five species demonstrated no remarkable variation in size of C-bands, indicating no tandem growth of heterochromatin.

The karyotype of *Atta colombica* (2n=22) is similar to that of three other species of the genus collected from Brazil (Fadini and Pompolo, 1996). These results demonstrate that the 2n=22 karyotype has been maintained in this genus.

In *Apterostigma* species, an intrageneric variation was noted, since the present *Ap. mayri* (2n=24) carried with all biarmed chromosomes and the other species *Ap.* sp. (2n=20) obtained from Brazil had two acrocentrics (Fadini and Pompolo, 1996). However, it is hard to determine chromosome rearrangements leading to the increase in chromosome numbers by centric fission, because the karyotype of *Ap. mayri* did not involve any acrocentric chromosomes.

The minimum interaction hypothesis of Imai *et al.* (1988) has been applied to the chromosome evolution in the tribe Attini by Fadini and Pompolo (1996) who found that the number of chromosomes in the higher attine ants were comparatively higher than that of the lower attine, due to centromeric fission. Although we

Table 1. Karyotype data of 10 attine ant species. The species are listed in order of their phylogenetic position

	N	No. of specimens (males : femels)	Chromosome no.		Formula		C-bands	
			n	2n	M	A	Cent.	In.
Higher attines								
Atta colombica	5	2 : 15	11	22	18	4	+	+
Sericomyrmex amabalis	3	0 : 5	–	50	50	0	+	+
Trachymyrmex septentrionalis	3	3 : 5	10	20	20	0	n.d.	n.d.
T. sp. 1	4	5 : 10	6	12	12	0	+	+
T. sp. 2	2	0 : 5	–	18	18	0	n.d.	n.d.
Lower attines								
Cyphomyrmex rimosus	5	0 : 5	–	32	28 ?	4 ?	n.d.	n.d.
C. costatus	3	0 : 3	–	20	20	0	+	–
Apterostigma mayri	5	0 : 5	–	24	24	0	+	–
Ap. sp.	4	0 : 4	–	24	24	0	n.d.	n.d.
Mycocepurus sp.	1	0 : 2	–	8	8	0	n.d.	n.d.

N=number of analyzed colony; M=metacentric; Ac=Acrocentric; Cent.=centromeric; In=interstitial

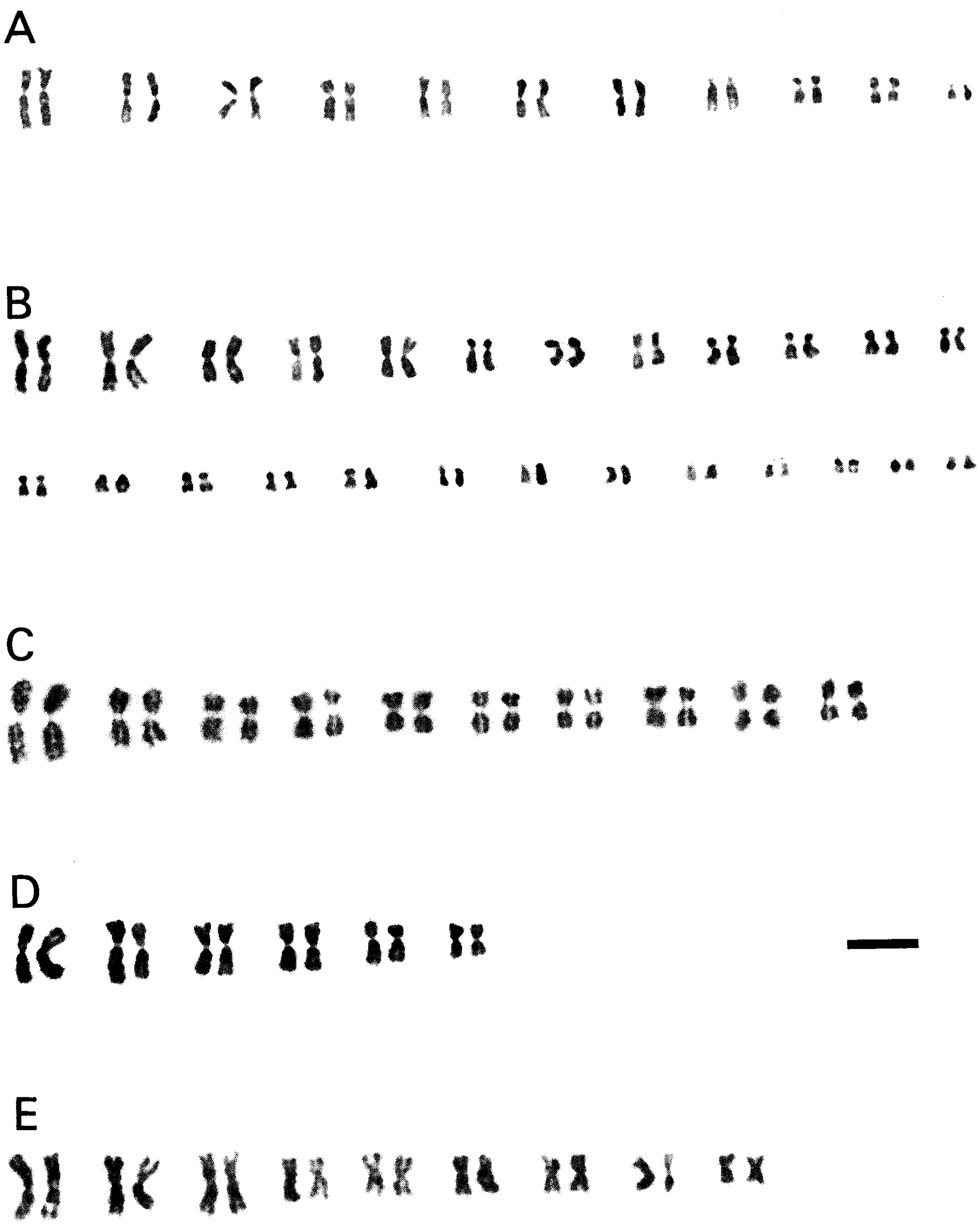

Figure 1. Karyotypes of higher attine ant species. A. *Atta colombica* (2n=22). B. *Sericomyrmex amabalis* (2n=50). C. *Trachymyrmex septentrionalis* (2n=20). D. *T.* sp. 1 (2n=12) E. *T.* sp. 2 (2n=18). Bar= 5 μm.

found 2n=8 to 2n=50 in the tribe Attini, we cannot clarify mechanisms of karyotypic change in this tribe from the present results. Further study for chromosome evolution in other attine genera is needed and may provide a valuable means for more exact identification of individual chromosomes.

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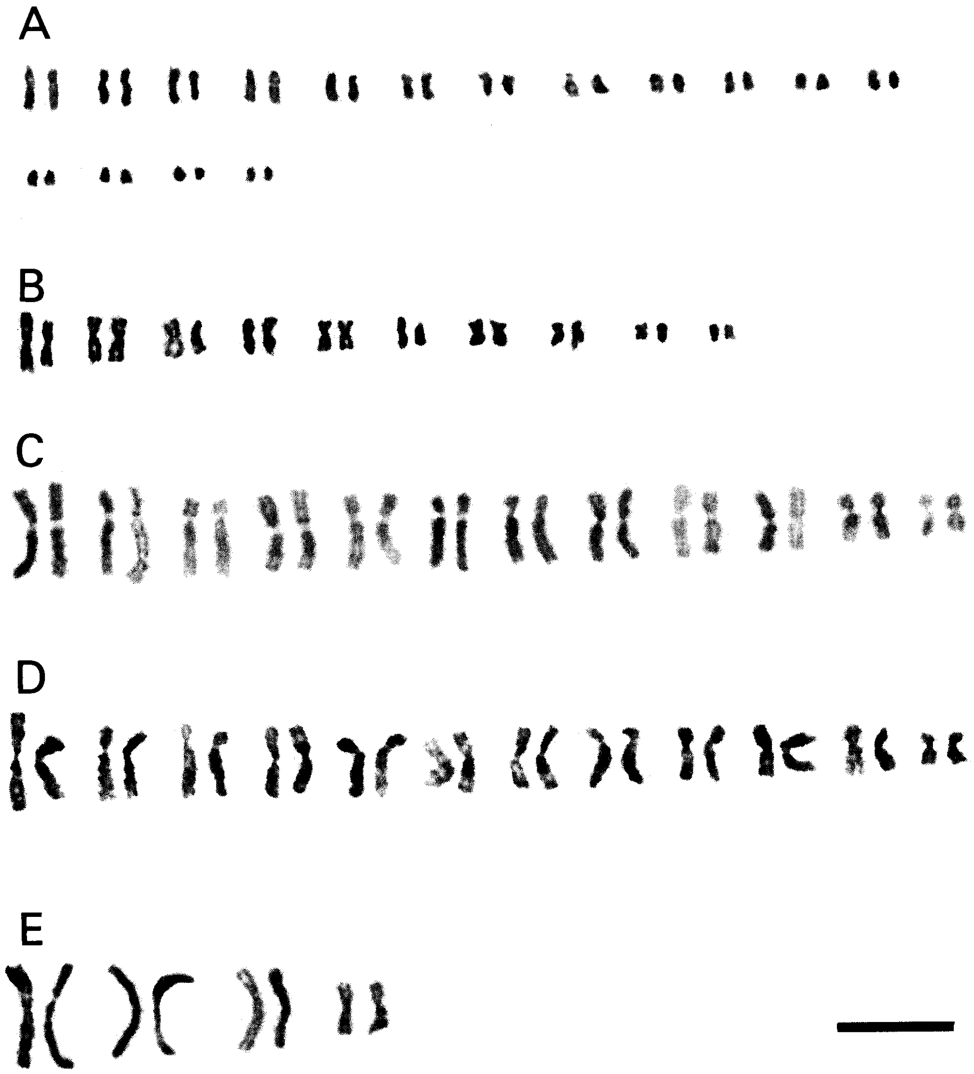

Figure. 2. Karyotypes of lower attine ant species. A. *Cyphomyrmex rimosus* (2n=32). B. *C. costatus* (2n=20). C. *Apterosotigma mayri* (2n=24). D. *Ap.* sp. (2n=24). E. *Mycocepurus* sp. (2n=8). Bar=5 μm.

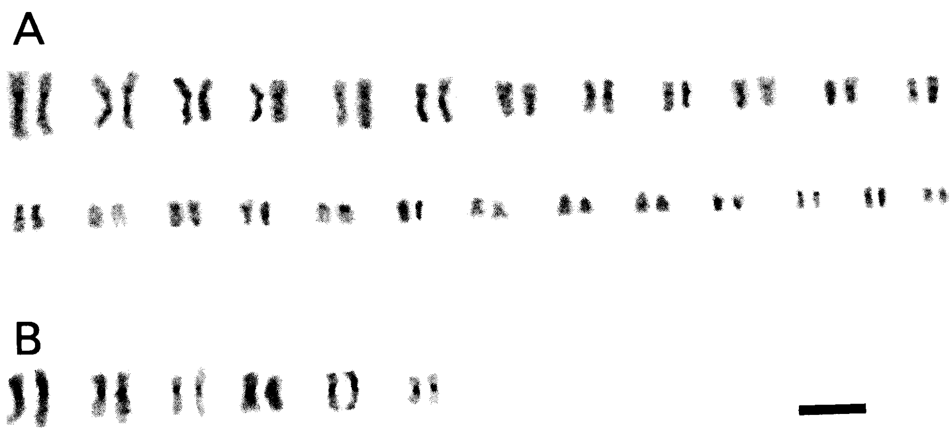

Figure 3. C-banded karyotypes of two attine ant species. A. *Sericomyrmex amabalis* (2n=50). B. *Trachymyrmex* sp. 1 (2n=12). Bar=5 μm.

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