17. Studies on the Karyotype Differentiation of the Norway Rat. XXII

*Karyotypes of Specimens collected in Miyake Island, Japan, with special regard to the Polymorphism of Pair Nos. 3, 11 and 12 and a Specimen with a Supernumerary or B-Chromosome**

By Tosihide H. YOSIDA

National Institute of Genetics, Misima

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It has been known that the karyotype of the Norway rat, *Rattus norvegicus*, was generally stable in the wild population, except a small inversion in some autosomes. The polymorphism due to the pericentric inversion of pair no. 3 has first been reported by Yosida and Amano (1965) in the natural population in Misima and in the laboratory strains of the Norway rats. The polymorphism of the no. 3 chromosome in the laboratory rats has been confirmed by Sasaki *et al.* (1978). The pair no. 3 chromosome polymorphism in the natural population has recently been reported in the Osaka population by Yosida and Harada (1985). A similar chromosome polymorphism due to the pericentric inversion has been found in pair no. 12 (no. 13 by the black rat system) and no. 11 in the laboratory rats (Masuji 1970; Sasaki *et al.* 1978) and in the natural population (Yosida 1980).

The cytogenetical investigation of the Norway rats in some small island is interesting because they would be isolated from the main land for a long time. By such a reason the karyotype of some specimens collected in Miyake island, Japan, was investigated. Among them one specimen had the supernumerary or B-chromosome in its karyotype. The supernumerary chromosome has been often observed in the black rat, *R. rattus* (Yosida 1980), but in the Norway rat it has not yet been reported so far. The present paper deals with the frequency of the chromosome polymorphism of pair nos. 3, 11 and 12 in these specimens and also a specimen with the supernumerary chromosome.

Material and methods. Five Norway rats, *Rattus norvegicus* (♀3:♂2) were collected in Miyake, Miyake island, Izu archipelago, Tokyo in 1978. The tail tip from the specimens was cultured and chromosomes were observed from the cultured cells. The conventional Giemsa, G- and C-band stainings by our routine procedure were carried out in these materials (Yosida 1980).

Results and discussion. 1) Polymorphism of pair nos. 3, 11 and 12: The basic karyotype of the Norway rat was represented to be $2n=42$ consisting of 12 acrocentric or subtelocentric autosome pairs (nos. 1 to 12) and 8 meta- or submetacentric autosome pairs (nos. 13 to 20) and acrocentric X and Y chromosomes. Among them pair nos. 3, 11 and 12 were found to be polymorphic in respect to acrocentric and subtelocentric types. The chromosome number and the shape of the pair nos. 3, 11 and 12 in these 5 specimens collected in Miyake island were shown in Table I. Among the 5 specimens, one male had 43 chromosomes, but the other 4 specimens (♀3:♂1) had the normal 42 chromosomes. The

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Table 1. Chromosome polymorphism of pair nos. 3, 11 and 12 in the Norway rats collected in Miyake island

Specimens	Sex	2n	Chromosome pair nos.		
			3	11	12
1	Male	43	A/A	A/S	S/S
2	Female	42	A/A	A/S	A/S
3	Female	42	A/S	A/A	A/A
4	Female	42	A/A	A/S	A/A
5	Male	42	A/S	A/A	A/S

A, acrocentric type; S, subtelocentric type.

Figs. 1-2. Karyotypes of the Norway rats with 42 and 43 chromosomes collected in Miyake island. 1: Female karyotype with 42 chromosomes. Pair no. 3 is heteromorphic by the acrocentric and subtelocentric types, but nos. 11 and 12 are the acrocentric homozygous pair. 2: Male karyotype with 43 chromosomes. Pair no. 3 is acrocentric homozygous, no. 11 is acrocentric and subtelocentric heterozygous and no. 12 is subtelocentric homozygous. One acrocentric supernumerary (B) is included.

pair no. 1 chromosomes in these specimens were subtelocentric as seen in the other Norway rats, but the nos. 3, 11 and 12 chromosomes were polymorphic in respect to acrocentric and subtelocentric types. On the pair no. 3, three specimens had acrocentric homomorphic pair (Fig. 2), but the other two showed the acrocentric and subtelocentric heteromorphism (Fig. 1). In the pair no. 11, three specimens showed the acrocentric and subtelocentric heteromorphism (Fig. 2), but two by the acrocentric homomorphic pair. On the pair no. 12, one specimen

was characterized by having the subtelocentric homomorphic pair (Fig. 2), two specimens were of the acrocentric homomorphic pair (Fig. 1) and the remaining one was heteromorphic due to the acrocentric and subtelocentric nature.

A statistical survey of the polymorphism in the pair no. 3 chromosome in the Norway rat has been carried out by Yosida and Amano (1965) in the Misima population and also by Yosida and Harada (1985) in the Osaka population, Japan. In the Misima population, the frequency of the A/S heteromorphic type was higher than the A/A homomorphic type, but in the Osaka population A/A type was rather higher than the A/S type. There was no any statistical survey of polymorphism of the pair nos. 11 and 12 in the natural population of the Norway rats. Therefore, the frequency of polymorphism in these chromosomes in rats

Figs. 3-4. G- and C-banding karyotypes of the Norway rat with a supernumerary chromosome (B). 3: G-banding karyotype. 4: C-banding karyotype. One acrocentric supernumerary (B) stained heavily is included in these cells.

collected in Miyake island could not be compared with that of the other population.

2) The supernumerary or B-chromosome found in a specimen: One male among five specimens collected in Miyake island had 43 chromosomes in all 20 cells examined so far. By the karyotype analysis, it was found that one acrocentric chromosome similar size to the pair no. 11 was included extraordinarily in this karyotype. Its size was slightly larger than the Y-chromosome (Fig. 2). By G-band staining, the extra acrocentric element was stained heavily along its whole length, but the middle part of the long arm, heavily stained band was observed (Fig. 3). On the other hand, the Y-chromosome was also stained through its whole body, but it was distinguished from the supernumerary one by the heavily staining band which was observed in the distal end of the long arm.

By the C-band staining, the supernumerary chromosomes were generally stained heavily along its whole length as seen in the black rat (Yosida 1980) and the raccoon dogs (Yosida *et al.* 1983, 1984). The supernumerary chromosome of the present specimen was also stained heavily through the whole length of the chromosome (Fig. 4). The supernumerary chromosome was easily identified from the other autosomes which stained only the centromeric region by the C-banding method. The Y-chromosome was also stained heavily along its whole length, but the Y- and supernumerary were identified by difference of their heavily staining part of their long arms; in the Y-chromosome the heavily staining part was observed in the middle position of the long arm, while in the supernumerary it was found in the distal end of the long arm. By the differences in the size, G-banding and C-banding, the supernumerary could be identified from the Y-chromosome.

The origin of the supernumerary chromosome found in this specimen, however, remains unknown at present. It also remains unknown whether, or not, the supernumerary found in the present material was distributed in the other specimens in this island. This male was mated to the normal females in the laboratory by our routine method, but any offspring was not obtained so far. The external feature of this male was normal and it had the normal scrotum and the penis. Although anatomical and histological investigations were not carried out on this specimen, this male would be sterile. If this specimen with the supernumerary was sterile, the B-chromosome would have occurred sporadically in this specimen in this island, and the heterochromatinization of the B-chromosome could have occurred during only one generation. This problem, however, must be concluded by the further observation of more number of the specimens in this island.

Summary. The karyotypes of 5 specimens of the Norway rats, *Rattus norvegicus*, collected in Miyake island, Tokyo, are investigated. Chromosome pair nos. 3, 11 and 12 are polymorphic due to the acrocentric and the subtelocentric types. One specimen among them is characterized by having 43 chromosomes, among which one acrocentric is a supernumerary or B-element.

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