

Karyotype and Presence of B-Chromosomes in Red Fox from Central Anatolia

Orta Anadolu'daki Kızıl Tilkinin Karyotipi ve B-Kromozomların Varlığı

Research Article

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ABSTRACT

Conventionally stained karyotype and Ag-NOR banded chromosomes of a male red fox (*Vulpes vulpes* L., 1758) from Kırıkkale province in Turkey were determined. The chromosome set included 16 banded autosomal pairs with two dot-like B chromosomes ($2n= 34 + 2B$, $NF=67$, $NFa=64$). The X chromosome was a large metacentric and the Y was a small acrocentric, almost similar in size of the Bs. The Ag-NOR regions were found in the telomeric regions of the long arm of three medium-sized metacentric autosomes.

Key Words

Vulpes vulpes, NOR distribution, supernumerary chromosomes, Turkey

ÖZET

Türkiye'deki Kırıkkale ilinden erkek bir kızıl tilki (*Vulpes vulpes* L., 1758)'nin standart boyanmış karyotipi ve Ag-NOR bantlı kromozomları tespit edilmiştir. Kromozom setinde iki nokta benzeri B kromozomu ile beraber 16 iki kollu otozomal çift yer almaktadır ($2n= 34 + 2B$, $NF=67$, $NFa=64$). X kromozomu büyük metasentrik, Y kromozomu ise hemen hemen B kromozomların büyüklüğünde küçük akrosetriktir. Ag-NOR bölgeler orta büyüklükteki üç metasentrik otozom çiftinin uzun kollarının telomerik bölgelerinde tespit edilmiştir.

Anahtar Kelimeler

Vulpes vulpes, NOR dağılımı, Ekstra kromozomlar, Türkiye

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INTRODUCTION

The red fox, *Vulpes vulpes* L., 1758, is distributed in the Holoarctic region including North America, Europe, North Africa and from Asia to Vietnam [1,2]. Hitherto, conventional and differential stained karyotypes of red fox were presented by Bugno-Poniewierska et al. [2], Wipf & Shackelford [3], Gustavsson & Sundt [4], Lin et al. [5], Graphodatsky et al. [6], Switonski et al. [7] and Breen [8] and the references therein. All the authors described a constant diploid chromosome number of $2n=34$ plus B chromosomes varied in number from 0 to 8 including biarmed autosomes, a metacentric X and an acrocentric Y in the set. The B chromosomes of the red fox were also determined as small acrocentrics.

The red fox is one of the most widespread carnivore distributed in Turkey [9-11]. Many studies were achieved on the ecology, biology, distribution, molecular, taxonomy and rabies epidemiology of red fox from Turkey [12-24] however, the karyotype of the species has not been reported.

The aim of this study is to characterize the karyotype of red fox from Turkey and contribute to the cytotaxonomy of the species in the Holoarctic region.

MATERIALS & METHODS

One male *Vulpes vulpes* specimen, shot by the hunters, was karyotypically studied from Kırıkkale, Yahsihan district (39° 51'N, 33° 13.42'E) in Central Anatolia. Chromosome preparations

were obtained from bone marrow, without *in vivo* colchicine treatment, according to the technique of Ford & Hamerton [25] therefore, we examined few metaphase plates. Nucleolar organizer regions (NORs) were detected with the method of Howell & Black [26]. 10 slides were prepared and at least 10 well conventionally stained and Ag-NOR banded metaphase plates were examined and arranged to determine the diploid chromosome number ($2n$), autosomal fundamental number (NFa) and fundamental number (NF) as well as the shapes of autosomes and the sex chromosomes. The voucher specimen is deposited at Kırıkkale University, Faculty of Science and Arts, Department of Biology.

RESULTS

The specimen showed a diploid number of $2n=34 + 2B$, NF= 67, and NFa= 64. The chromosome set was composed of 16 metacentric/submetacentric autosomes. The X chromosome was a large metacentric while the Y was a small acrocentric. In addition, we detected two B chromosomes in the examined metaphases (Figure 1).

The Ag-NOR regions were detected in the telomere region of the q arms of three medium-sized metacentric autosomes (nos. 8, 9, 13) (Figure 2).

DISCUSSION

The family of Canidae is composed of species with different diploid chromosome number with

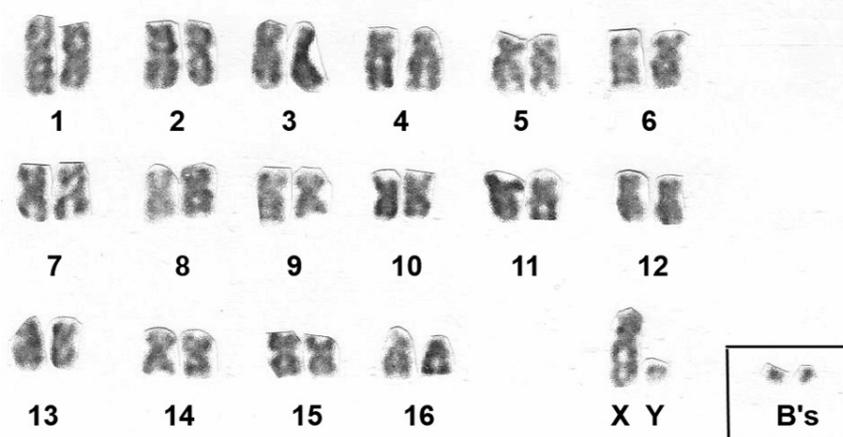


Figure 1. Conventional Giemsa stained karyotype of a male *Vulpes vulpes* ($2n=34 + 2B$, NF=67). In the inset, the B chromosomes of the set.



Figure 2. Silver stained metaphase plate of *Vulpes vulpes*. (Arrows indicate the homomorphic NOR - bearing chromosomes).

regard to various number of the supernumerary B chromosomes in some species (such as red fox, silver fox and racoon dogs), although the fundamental number relatively remained constant [4,7]. Graphodatsky et al. [6] stated that the red fox and its domesticated form, the silver fox, possessed 34 biarmed chromosomes and B chromosomes varied in number. However, the Arctic fox and its domesticated form, the blue fox, possessed a karyotype of $2n=48$. The diploid chromosome number and the number of Bs of the specimen from Turkey were in accordance with the conservative karyotype of red fox.

Number of Ag-NORs was characteristic for the red fox [2]. The number of NOR- bearing chromosomes in red fox was firstly described by Mäkinen [27] and according to the author NORs were located in the long arms of autosome pairs nos. 8, 9 and 13. Afterwards, Mäkinen et al. [28,29] determined the same NOR-bearing autosomes in silver fox. Recently, Bugno-Paniewierska et al. [2] examined the karyotype of red fox and stated that the chromosome set is composed of biarmed chromosomes with a metacentric X and an acrocentric Y. Unlike the common opinion for the number of NOR bearing autosomes, the authors recorded the number as 0 - 4 for farm foxes, whereas 0 - 6 for wild foxes. However, the authors also found 8 NOR-bearing chromosomes in a single cell of a wild population of red fox. In this study, our specimen from Turkey revealed the

Ag-NORs in three pairs as stated by Mäkinen [27].

B chromosomes are recorded in fungi, plants and animals. Hitherto, Bs have been recorded in 55 mammalian species [30]. According to the hypothesis of Volobuev [31] B chromosomes are originated from A chromosome complement by non-disjunction, Robertsonian translocation, deletion or isochromosome formation and they were genetically inactivated. Yang et al. [32] stated the B chromosomes of the red fox as to be rich in centromeric- like sequences. However, Mäkinen [27] determined the B chromosomes as C-banded negative. Rarely B chromosomes are reported as C-negative however, mostly small or large B chromosomes possessed darkly stained C-bands [30]. We can not determine the structure of G- or C-bands because of an almost dead single specimen examined in this study.

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