

A Karyological Analysis of *Garra rufa* (Heckel, 1843) (Pisces, Cyprinidae) from the Eastern Mediterranean River Basin in Turkey

Serap ERGENE GÖZÜKARA*, Tolga ÇAVAŞ
Department of Biology, Faculty of Science & Arts, Mersin University 33342, Mersin - TURKEY

Received: 26.09.2002

Abstract: A cytogenetic investigation on 12 *Garra rufa* (Heckel, 1843) specimens, from Müftü stream, was carried out by a slight modification of the conventional air-dried technique, using gill epithelial cells. The diploid chromosome number of this species was $2n = 44$, comprising 22 metacentric and 20 submetacentric chromosomes and 2 acrocentric chromosome carrying satellites (NF = 85). A haploid idiogram, based on the chromosome measurements, was prepared. A detailed standard karyotype of *G. rufa* was established for the first time in this study.

Key Words: *Garra rufa*, karyotype, Eastern Mediterranean, stream, Turkey

Türkiye'nin Doğu Akdeniz Nehirlerinde Bulunan *Garra rufa* (Heckel, 1843) (Pisces, Cyprinidae)'nın Bir Karyolojik Analizi

Özet: Bu çalışmada Müftü deresinden yakalanan 12 *Garra rufa* örneğinin solungaç epitel hücrelerinde Havada Kurutma Yöntemi değişikliğe uğratılarak bir sitogenetik inceleme yapılmıştır. Karyotipik analiz sonucunda *G. rufa*'nın $2n = 44$ kromozom sayısına ve 22 Metasentrik, 20 Submetasentrik, satelit taşıyan 2 Akrosentrik kromozoma sahip olduğu tespit edilmiştir (NF = 85). Haploit idiogram, kromozom ölçümleri yapılarak hazırlanmıştır. Bu çalışmada *G. rufa*'nın karyotipi ilk kez detaylı olarak tanımlanmıştır.

Anahtar Sözcükler: *Garra rufa*, karyotip, Doğu Akdeniz, dere, Türkiye

Introduction

Cytogenetic studies on fish have received considerable attention in recent years (1,2). Fish chromosome data have great importance in studies concerning evolution, systematics, aquaculture and mutagenesis (3,4). Although many different techniques (culturing leucocytes and fibroblasts etc.) to obtain chromosomes have been described to date, chromosome studies in fish have not been as successful as those in other vertebrates because of the relatively small size and large numbers of chromosomes found in many fish species and the limitations of the techniques employed (5). The air-drying technique, originally developed for mammalian organisms, is the most common procedure used for chromosome preparations in fish. While the main steps

are the same, many small modifications have been applied to this technique for each species (6,7).

The increasing importance of chromosomal studies on fish and the lack of data on fish karyotypes in Turkey (8-11), prompted us to examine the chromosomal content of *Garra rufa*, a cyprinid fish. This species, as mentioned by Arkhipchuk (12), is known as a doctor fish. It apparently feeds on skin scales and is used in the treatment of neurodermitis (12). This fish lives in Sivas' thermal waters and is used to treat psoriasis (13). It is known as an oily fish (14).

In this study, cytogenetic analysis of *G. rufa*, a cyprinid fish from Eastern Mediterranean river basins, was carried out with the air-drying technique to determine its basic karyological structure.

* Correspondence to: sergene@mersin.edu.tr

Materials and Methods

G. rufa specimens were collected by seine from the Müftü stream and maintained in the laboratory in well aerated aquariums. Cytogenetic analyses were carried out on 12 specimens as follows: individuals were intraperitoneally (ip) injected with 0.1 ml of 0.1% phytohemaglutinine (Gibco) per gram of body weight (bw) (15). After 45 h, they were injected (ip) with 0.01 ml/g (bw) of a 0.5% solution of colchicine and were decapitated after 3 h. Gill arches were removed and minced to obtain an epithelial cell suspension. This suspension was pipetted into centrifuge tubes. After hypotonic treatment with distilled water for 60 min they were centrifuged for 10 min at 2000 rpm, the supernatant was removed and the cells were fixed in methanol:acetic acid (3:1). The fixative was changed by 3

successive centrifugations for 10 min at 2000 rpm. Preparations were made using the air-drying technique and slides were stained with 5% Giemsa for 20 min. Photographs were taken using an Olympus BX-40 microscope. The arm ratios and centromeric indices of metaphase chromosomes were determined using the method recommended by Levan et al. (16).

Results

The chromosome number of *G. rufa* was $2n = 44$ ($NF = 85$), comprising 11 metacentric and 10 submetacentric chromosomes and an acrocentric chromosome carrying satellites. The karyotype and haploid idiogram of this species are shown in Figures 1 and 2, respectively. The measurements used to classify the chromosomes are given in the Table.

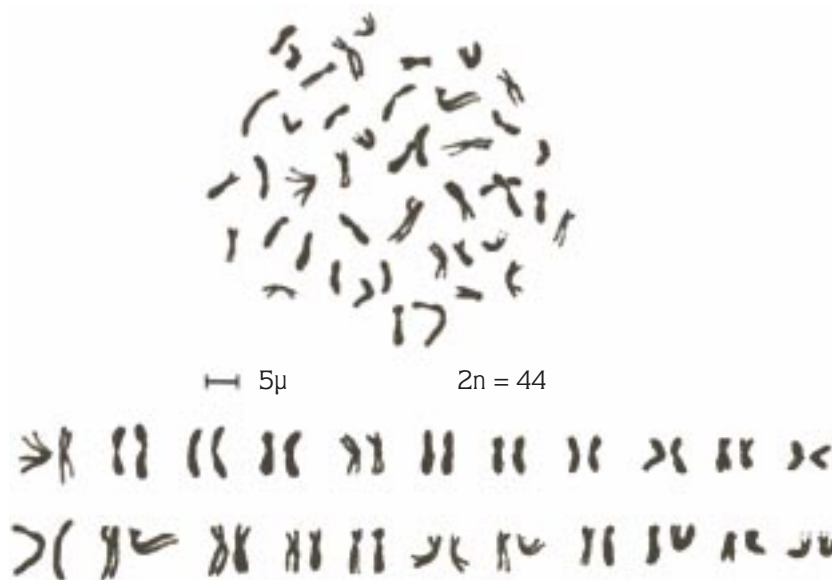


Figure 1. Karyotype of *Garra rufa*.

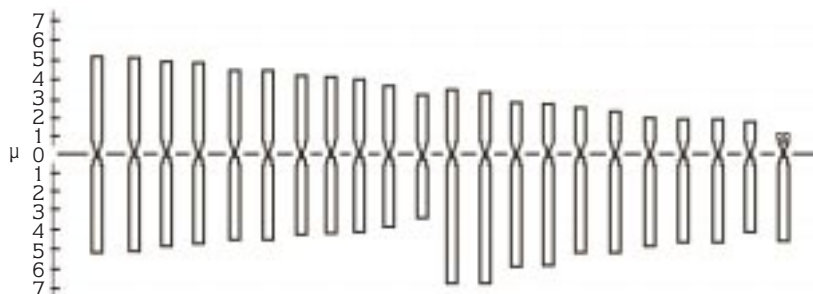


Figure 2. Haploid idiogram of *Garra rufa*.

Table 1. Chromosome measurements and classification (M: Metacentric; SM: Submetacentric and A: Acrocentric).

Chromosome Number	Long Arm	Short Arm	Total Length	Arm Ratio	Chromosome Type
1	5.1	5.1	10.2	1	M
2	5.0	5.0	10	1	M
3	4.8	4.8	9.6	1	M
4	4.7	4.7	9.4	1	M
5	4.4	4.4	8.8	1	M
6	4.4	4.4	8.8	1	M
7	4.2	4.2	8.4	1	M
8	4.1	4.1	8.2	1	M
9	4.0	4.0	8.0	1	M
10	3.8	3.8	7.6	1	M
11	3.5	3.5	7.0	1	M
12	3.7	6.4	11.1	1.72	SM
13	3.6	6.3	9.9	1.75	SM
14	3.1	5.8	8.9	1.87	SM
15	3.0	5.8	8.8	1.93	SM
16	2.8	5.1	7.3	1.82	SM
17	2.6	5.0	7.6	1.92	SM
18	2.3	4.7	7.0	2.04	SM
19	2.2	4.5	6.7	2.04	SM
20	2.2	4.5	6.7	2.04	SM
21	2.1	4.0	6.1	1.90	SM
22	0.6	4.6	5.2	7.60	A

When the arm number (NF: 78) was calculated, metacentric and submetacentric chromosomes were considered bi-armed; the subtelo-centric and acrocentric chromosomes were considered mono-armed (16).

Discussion

According to the last 3 databases of fish chromosomes, published by Al-Sabti (4), Klinkhardt et al. (17), Arkhipchuk (12) and Froese and Pauly (18), the only reference concerning the karyotype of *G. rufa* was published by Post in 1965 (18). However, according to Froese and Pauly (18), Post reported that the haploid chromosome number of this species is $n = 22-26$, but

without any information about arm numbers (NF) or chromosome types. Thus, this study may be considered the first to describe the detailed chromosomal complement of *G. rufa*.

The cyprinids form a very large and important family of fish, and its members are distributed worldwide. The distribution areas of *G. rufa* were reported as Iran, Iraq, Jordan and inland waters of Turkey including the Orontes, Euphrates and Tigris river basins (12,14,19) and some coastal rivers in southern Turkey and northern Syria (12). With this information on the karyologic structure of this species living in Turkey's freshwater systems, additional data is provided for the fish cytogenetic database.

References

1. Galetti, P.M., Aguliar, C.T., Molina, W.F.: An overview of marine fish cytogenetics. *Hydrobiologia*. 2000; 420: 55-62.
2. Ozouf-Costaz C., Foresti F.: Fish Cytogenetic Research: Advances, Applications and Perspectives. *Neth. J. Zool.* 1992; 42: 277-290.
3. Amemiya, C.T.: Cytogenetic and Cytosystematic Studies on the Nucleolus Organizer Regions of North American Cyprinid fishes. Texas A&M University. Ph.D. Thesis, 1986.
4. Al-Sabti K.: Handbook of Genotoxic Effects and Fish Chromosomes. J. Stephan Institute, PO Box 100, Jamova 39, 1991, Ljubljana Yugoslavia.
5. Klinkhardt, M.B.: A brief comparison of methods for preparing fish chromosomes: an overview. *Cytobios.* 1991; 67: 193-208.
6. Foresti, F., Olivera, C., Almedia-Toledo, F.: A method for chromosome preparations from large fish specimens using in-vitro s-term treatment with colchicine. *Experientia.* 1993; 49: 810-813.
7. Cucchi, C., Barufaldi, A.: A New Method for Karyological Studies in Teleost Fishes. *J. Fish Biol.* 1990, 37: 71-75.
8. Ergene Gözükara, S., Kuru, M., Çavaş, T.: Karyological analysis of *Barbus plebejus* (Heckel, 1843). 2nd International Kızılırmak Congress of Applied Sciences. 20-22 May, Kırıkkale Turkey, 1999, 426-433.
9. Ergene, S., Portakal, E., Karahan, A.: Karyological analysis and body proportion of Catfish (Clariidae, *Clarias lazera*, Valenciennes. 1840) in Göksu Delta, Turkey. *Tr. J. of Zoology.* 1999; 23: 423-426.
10. Ergene Gözükara, S., Çavaş, T.: Cytogenetic Analysis of *Garra rufa* (Heckel, 1843) from Eastern Mediterranean River Systems. Third European Cytogenetics Conf. Paris, Ann. Gen. Par., 2001; 44: 43.
11. Ergene Gözükara, S., Çavaş T.: Karyological Analysis of *Gobius pagenellus* L., 1758 (Pisces; Gobiidae) in Mersin, Turkey. *Folia Biol. Krakow.* 2002; 50: 5-7.
12. Arkhipchuk, V.V.: Database of Fish chromosomes. 1999, At <http://www.fishbase.org>
13. Kuru, M. Vertebrate Animals, Palme Press, 1999, (in Turkish).
14. Geldiay, R., Balık S.: Freshwater Fishes of Turkey, Ege Univ. Press, 1996, (in Turkish).
15. Ergene, S., Kaya, F., Pekcan, I., Oral, A.: Karyological analysis of *Oreochromis niloticus* (L., 1758) (Pisces, Cichlidae) used in Aquaculture. First Intern. Symp. on Fisheries & Ecology Proc., 2-4 September, Trabzon, Turkey, 1998, 191-195.
16. Levan, A., Fredga, K., Sandberg, A.A.: Nomenclature for centromeric position on chromosomes. *Hereditas.* 1964; 52: 201-220.
17. Klinkhardt, M.N., Tesche, M., Greven, H.: Database of Fish Chromosomes. Westarp Wissenschaften Verlag. Germany, 1995.
18. Froese, R., D. Pauly.: Editors. FishBase. World Wide Web electronic publication, 2001, <http://www.fishbase.org/>, 11 June 2001.
19. Kuru M.: Key to the inland waters of Turkey. Hacettepe Bulletin of Science and Engineering. 1980; 9: 103-133.