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Karyotypes of Two Species of Cultrinae (Cyprinidae) from Korea

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The chromosome numbers of two species (*Culter brevicauda* and *Erythroculter erythropterus*) of Korean Cultrinae are investigated. In two species, the mitotic chromosomes from 24 groups with two chromosomes each indicated that it is a diploid. Their karyotypes and total length of chromosomes were slightly different from each other. The karyotype of *C. brevicauda* and *E. erthropterus* is 2n=48 (7M+10SM+7ST), FN=96 and 2n=48 (6M+10SM+8ST), FN=96. Observed chromosomes of *C. brevicauda* and *E. erythropter*us ranged from 5.4 to 2.2 μm and 6.1 to 2.3 μm in length, respectively.

Key words : diploid chromosomes, Cyprinidae, *Culter brevicauda*, *Erythroculter erythropterus*, karyotypes, Korea

Introduction

In Korea, 74 species of Cyprinidae are recognized (Kim *et al.*, 2005a, b). The chromosome numbers of about 50 species belonging to the Cyprinidae family have been reported previously (Lee *et al.*, 1983; Ueno and Ojima, 1984; Lee *et al.*, 1984; Yu *et al.*, 1987; Kim and Park, 2002; Gozukara and Cavas, 2004). Comparsion of karyotypes between related taxa has been expected to be a helpful tool to solve problems in systematics and phylogenetic studies. The primitive karyotype of cyprinid fishes may be inferred as being 2n=50.

In the Korean peninsula, the subfamily Cultrinae has been reported by four species (Uchida, 1939; Berg, 1949; Kim and Lee, 1985, 1986). This paper presents the chromosome numbers and the karyotypes of *Culter brevicauda* and *Erythroculter erythropterus*.

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Materials and Methods

Two species used in this study were collected in Andong Lake (*C. brevicauda*) and Chungju Lake (*E. erythropterus*) during July 2007. The specimens were brought alive to the laboratory, where the gills were fixed and preserved in Carnoy's fluids for study by the air-drying method (Park and Song, 2006). Morphological features of the chromosomes used to compare karyotypes were the total lengths and the relative lengths of the chromosomes, as well as the positions of their centromeres (primary constrictions). Nomenclature of chromosome morphological types follows Levan *et al.* (1964). To estimate the NF value, the chromosomes of the group meta- and submetacentric were scored as bi-armed and the chromosomes of the group acrocentric as uni-armed. Voucher specimens of the two species used in this investigation have been placed in the Department of Parasitology, Kwandong University College of Medicine, Korea.

Results

1. *C. brevicauda*

A microphotograph of somatic metaphase chromosomes and the karyogram are shown in Fig. 1 and measurements of the chromosomes in Table 1. The diploid chromosome number was 48 (FN= 96). The somatic complement consisted of 7 pairs metacentric, 10 pairs submetacentric and 7 pairs subtelocentric chromosomes. Total length of each chromosome ranged from 2.2 to 5.4 μm, and relative length of each chromosome ranged from 6.14 to 2.53 (Table 1). Mean total length of the metaphase chromosomes in haploid complement was 84.76±3.10 μm (mean±SD; Table 1).

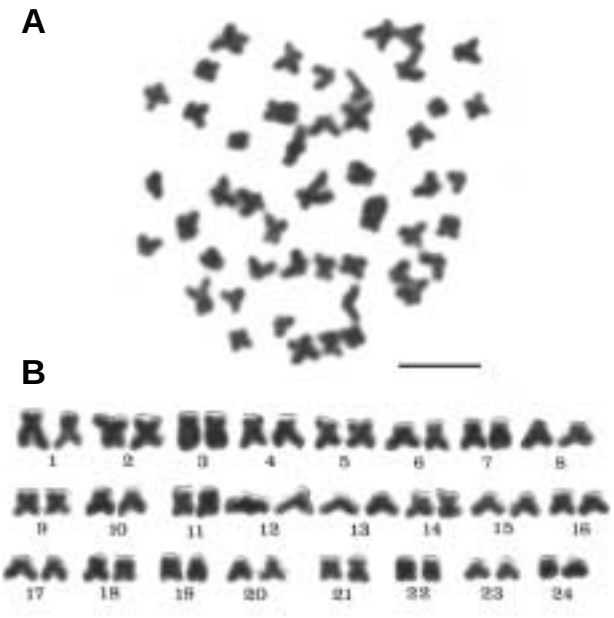

Fig. 1. A, Metaphase chromosome of *Culter brevicauda*; B, Karyotype constructed from A. Scale bar indicates 10 μm.

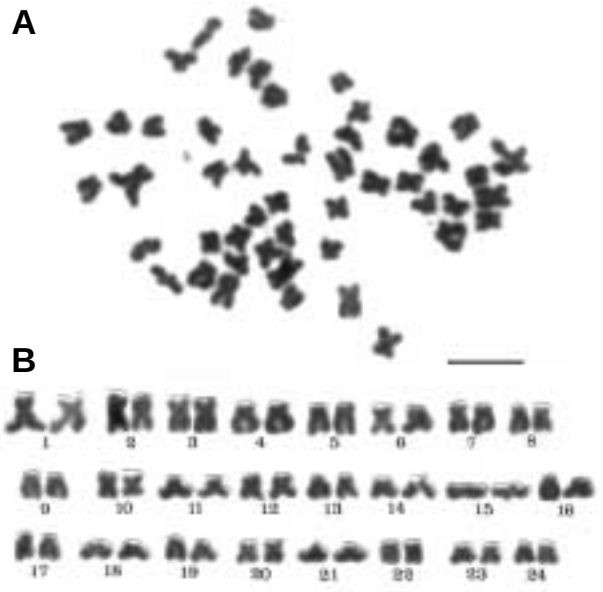

Fig. 2. A, Metaphase chromosome of *Erythroculter erythropterus*; B, Karyotype constructed from A. Scale bar indicates 10 μm.

2. *E. erythropterus*

A microphotograph of somatic metaphase chromosomes and the karyogram are shown in Fig. 2 and measurements of the chromosomes in Table 2. The diploid chromosome number was 48 (FN= 96). The somatic complement consisted of 6 pairs metacentric, 10 pairs submetacentric and 8 pairs subtelocentric chromosomes. Total length of each chromosome ranged from 2.3 to 6.1 μm, and relative length of each chromosome ranged from 6.90 to 2.62 (Table 2). Mean total length of the meta-

Table 1. Relative lengths and total lengths (μm) of chromosomes of *Culter brevicauda**

Chromosome no.	RL±SD	TL±SD	Type
1	6.14±0.31	5.40±0.23	SM
2	5.85±0.22	5.14±0.30	M
3	5.59±0.16	4.92±0.12	SM
4	5.39±0.14	4.74±0.21	SM
5	5.15±0.21	4.53±0.12	M
6	4.82±0.30	4.24±0.13	SM
7	4.63±0.21	4.07±0.09	SM
8	4.46±0.16	3.92±0.17	SM
9	4.33±0.17	3.81±0.10	M
10	4.30±0.13	3.78±0.12	SM
11	4.06±0.12	3.57±0.13	M
12	3.93±0.27	3.46±0.11	ST
13	3.85±0.13	3.39±0.12	ST
14	3.73±0.13	3.28±0.09	M
15	3.46±0.09	3.04±0.12	ST
16	3.33±0.15	2.93±0.09	SM
17	3.23±0.14	2.84±0.11	ST
18	3.22±0.13	2.83±0.08	M
19	3.17±0.10	2.79±0.10	ST
20	2.93±0.11	2.58±0.12	ST
21	2.85±0.12	2.51±0.16	M
22	2.76±0.19	2.43±0.12	SM
23	2.65±0.19	2.33±0.09	ST
24	2.53±0.19	2.23±0.07	SM

*Based on measurement of two karyotyped cells. RL±SD, relative length of the chromosome (percentage of the total length of the autosomes in diploid); TL, total length of the autosomes in diploid; SD, standard deviation; M, metacentric chromosomes; SM, submetacentric chromosomes; ST, subtelocentric chromosomes.

Table 2. Relative lengths and total lengths (μm) of chromosomes of *Erythroculter erythropterus**

Chromosome no.	RL±SD	TL±SD	TYPE
1	6.90±0.60	6.07±0.30	SM
2	6.13±0.28	5.38±0.24	M
3	5.60±0.12	4.92±0.31	SM
4	5.08±0.36	4.46±0.22	SM
5	4.34±0.42	3.81±0.22	SM
6	4.26±0.14	3.74±0.14	M
7	4.21±0.22	3.70±0.16	SM
8	4.14±0.13	3.64±0.12	SM
9	4.09±0.14	3.59±0.20	ST
10	4.02±0.21	3.53±0.12	M
11	3.96±0.22	3.48±0.15	SM
12	3.89±0.16	3.42±0.11	M
13	3.80±0.08	3.34±0.16	SM
14	3.61±0.12	3.17±0.12	SM
15	3.57±0.16	3.14±0.09	ST
16	3.52±0.13	3.09±0.13	ST
17	3.46±0.15	3.04±0.15	ST
18	3.37±0.17	2.96±0.11	ST
19	3.29±0.13	2.89±0.15	ST
20	3.05±0.16	2.68±0.12	M
21	3.00±0.12	2.64±0.08	ST
22	3.20±0.10	2.51±0.13	M
23	2.73±0.22	2.40±0.16	SM
24	2.62±0.14	2.30±0.17	ST

*Based on measurement of two karyotyped cells

phase chromosomes in haploid complement was 83.90±3.86 μm (mean±SD; Table 1).

Discussion

Detailed studies of chromosome morphology and population cytology of the present fishes are very little can be said on systematics based on the karyotypes other than chromosome numbers. In fact modern cytogenetic techniques have only recently been adopted for studies of fishes. Chromosomal information on a total of 300 species from cyprinid fishes (Lee *et al.*, 1983, 1984; Yu *et al.*, 1987; Song and Park, 2005).

Yu *et al.* (1987) have been reported that the diploid chromosome numbers were found to be 2n =50 and 2n=48, amounting to 43% and 33% respectively of all the cyprinid fishes karyotyped in China. Also, in the Korean cyprinid species, 53 species have been karyologically investigated, 2n range from 44 to 76 (Song and Park, 2005). The most frequent chromosome number were 2n=50 and 2n=48, amounting to 60% and 21% respectively. For the present study, two species of Cultrinae have 2n=48 chromosomes.

As all of the organism's genomic DNA residues in its chromosomes, chromosome size and number will reflect the size of the whole genome. Despite this, less attention has been paid to the length of the mitotic metaphase chromosomes or the total length than to the chromosome numbers of fishes. In this study, the total length of chromosomes of two Cultrinae species was very similar, which measured 84.76±3.10 μm and 83.90±3.86 μm, respectively.

Though the chromosome number is the same between these two species, the karyotype is different. *C. brevicauda* has 7 pairs of M, 10 pairs of SM and 7 pairs of ST, whereas *E. erythropterus* has 6 pairs of M, 10 pairs of SM and 8 pairs of ST. Fundamental number (FN) for 10 subfamilies of Cyprinidae in China have been calculated and range from 68 to 254. In this study, *C. brevicauda* and *E. erythropterus* was 96, respectively.

Recent molecular studies in fishes have provided gene sequences in fishes which are clarifying taxonomic relationships (Eah *et al.*, 2006; Song and Park, 2006). Finally, the future accumulation of the chromosomal information on the pisces with modern techniques will aid in elucidation and clarification of these tentative characterizations.

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한국산 강준치아과(Cultrinae) 2종의 핵형분석

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한국산 강준치아과 (Cultrinae)의 백조어와 강준치 2종의 염색체 수 및 핵형 분석을 실시하였다. 백조어와 강준치의 염색체 수 및 핵형은 2n=48 (7M+10SM+7ST), FN=96 그리고 2n=48 (6M+10SM+8ST), FN=96으로 밝혀졌다. 염색체의 크기는 백조어에서 가장 큰 염색체 쌍과 가장 작은 염색체 쌍은 각각 5.4μm와 2.2μm였으며, 강준치의 경우 6.1μm와 2.3μm를 보였다.