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KARYOMORPHOLOGY OF *LIZA PARSIA* (HAMILTON & BUCHANAN) AND *MUGIL CEPHALUS* L.

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SUMMARY

Karyomorphology of the mullets, *Mugil cephalus* and *Liza parsia* belonging to the family Mugilidae has been studied. The diploid chromosome complements are confirmed as 2n = 48 and all chromosomes are acrocentric. The size of chromosomes varied between 4.80 and 2.12 µm in *L. parsia* whereas in *M. cephalus* it varied between 5.52 and 2.25 µm. The relative lengths of chromosomes varied between 5.33 and 2.36% in *L. parsia* whereas in *M. cephalus* its ranges were between 6.40 and 2.60%. According to the relative length, 5 groups of chromosome pairs were recognised.

Key Words : Karyomorphology, mullets, *Liza parsia*, *Mugil cephalus*.

INTRODUCTION

Mullets are mainly distributed in tropical and subtropical waters around the world and a few of them occur in temperate zones. *L. parsia* and *M. cephalus* belonging to the family Mugilidae are widely distributed in the east and west coast of India, and are commercially important fishes (Jhingran 1991). Karyomorphological studies of a species can give the basic information regarding the chromosome number, size and shape which is a prerequisite for any genetic improvement of the species and have extensive application in population studies of fishes (Arcement & Rachlin 1976, Rachlin et al. 1978). Though 20,000-23,000 living species of fishes were taxonomically described, chromosome numbers are known only for about 650-700 species and complete karyotypes have been made in about 500 species (Gold 1979). Cataudella & Capanna (1973), Le Grande & Fitzsimons (1976), Khuda Bukhsh & Manna (1976), Nayak & Khuda Bukhsh (1991) and Joradao et al. (1992) studied the chromosomes of mullets.

Various methods have been suggested for chromosome preparations of fishes by Mc Phail & Jones (1966), Chen & Ebeling (1968), Denton & Howell (1969), Kligerman & Bloom (1977) and Reddy & John (1986). The present study was, therefore, initiated to establish the karyotypes of *L. parsia* and *M. cephalus* from the west coast of India, and to set the foundation for future comparative population studies of mullets and other members of the family Mugilidae.

MATERIALS AND METHODS

Live specimens of male and female of *L. parsia* and *M. cephalus* of 100 to 150 mm size were collected by Chinese dip net from the west coast of India for chromosome preparations. Identification was made as per the FAO species

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identification sheet, 1983, Fishing area 51 for *L. parsia* and 1974 , Fishing area 57, 71, pp. 65, 77-82 for *M. cephalus*. Soon after collection in the morning and evening, 4-6 fishes were transferred to 15 l transportation bag containing two-third of brackish water, and ice blocks were added to reduce the water temperature during transportation. In the laboratory, the fishes were acclimatised for 20 d in a one ton polycraft pool fitted with biological filter containing brackish water. During this period the salinity was maintained between 2 and 5 ppt, water temperature 27 to 29°C, pH 8.1-8.2, dissolved oxygen 3.5-6.5 ml/l and the fishes were fed on live filamentous algae in the morning and evening.

For chromosome preparations, methods suggested by Mc Phail & Jones (1966), Kligerman & Bloom (1977) and Reddy & John (1986) were tried with slight modifications to obtain best metaphase spread of *L. parsia* and *M. cephalus*. Before tissues were taken and fixed, the live fishes were injected intramuscularly 0.01% colchicine solution at the rate of 1 ml/100 g of body weight and thereafter kept alive for at least 2 and a half in a well aerated aquaria. After this, gill, liver and kidney tissues were removed, treated in 1% of sodium citrate solution for 30 min, diced and fixed in a freshly prepared methanol and acetic acid (3:1) with 3 changes of 15 min duration and stored under refrigeration for 2 and a half and overnight cold fixation was also conducted. The chopped tissues were placed in a cell suspension (50% glacial acetic acid) after the methanol was completely evaporated and then the tissue suspensions were dropped in a warm slide (40-50°C). The dropped slides were then air dried and stained in 4% Giemsa stain in a 0.1 molar phospate buffer for 18-20 min. For karyotyping, the chromosomes were cut out from the photomicrograph of well spread metaphase plates and paired on the basis of size. Chromosome analysis was made according to the system of Levan et al. (1964). Chromosome length (µm) and its standard deviation, relative length (%) were measured from metaphase plate. The relative length was expressed as 100 times the absolute chromosome pair length (µm) divided by total length of haploid complement. In order to compare the chromosome pairs of these species, histograms were constructed from relative length.

OBSERVATIONS

The diploid complement of 2 n = 48 that recurs consistently and has been scored in 184 out of 344 metaphases on 18 individuals in *L. parsia* and 205 out of 300 metaphases observed on 15 individuals of *M. cephalus*. The frequency distributions of chromosomes in these 2 species are given in Fig. 1. The distribution of these counts is skewed to the lower value, probably as a consequence of premature nuclear membrane rupture during preparation, resulting in the loss of chromosome. The number of counts greater than the mode is low. The size and relative length of chromosomes range from 4.80 to 2.12 µm and 5.33 to 2.36% respectively in *L. parsia* whereas in the case of *M. cephalus* the corresponding values are 5.52 to 2.25 µm and 6.40 and 2.60% (Table 1). Of the 3 tissues viz., gill, liver and kidney the gill tissue gave best results. The karyotype of these 2 species consist of 48 acrocentric chromosomes (Figs 2-5). No differences in chromosome complements and configurations were observed between male and female of these 2 species but a slight variation in lengths of chromosomes was noticed. According to the relative length we recognise 5 groups of chromosome pairs, numbered in the order of decreasing size (Fig.6).

The groups are also justified by rank order similarities in length. Groups have the following rank order of increasing size (LP= *L. parsia* , MC = *M. cephalus)* group I-MC >LP, group II and IV -LP>MC, group III-LP≥MC and group V - MC≥LP. Within groups II and IV, sizes are very similar in these 2 species. Group IV and V are always smaller than those of group I , II and III and therefore, readily identifiable. The analysis of these results shows that some common characteristics are existing within the species.

DISCUSSION

Our results confirmed the diploid chromosome number in *L. parsia* and *M. cephalus* as 2n =48. The same number was also reported in *L. ramada, L. saliens, L. aurata, Chaleon labrosus* and *M. cephalus* (Cataudella & Capanna 1973), *M. parsia* and *M. corsula* (Kudha Bukhsh & Manna

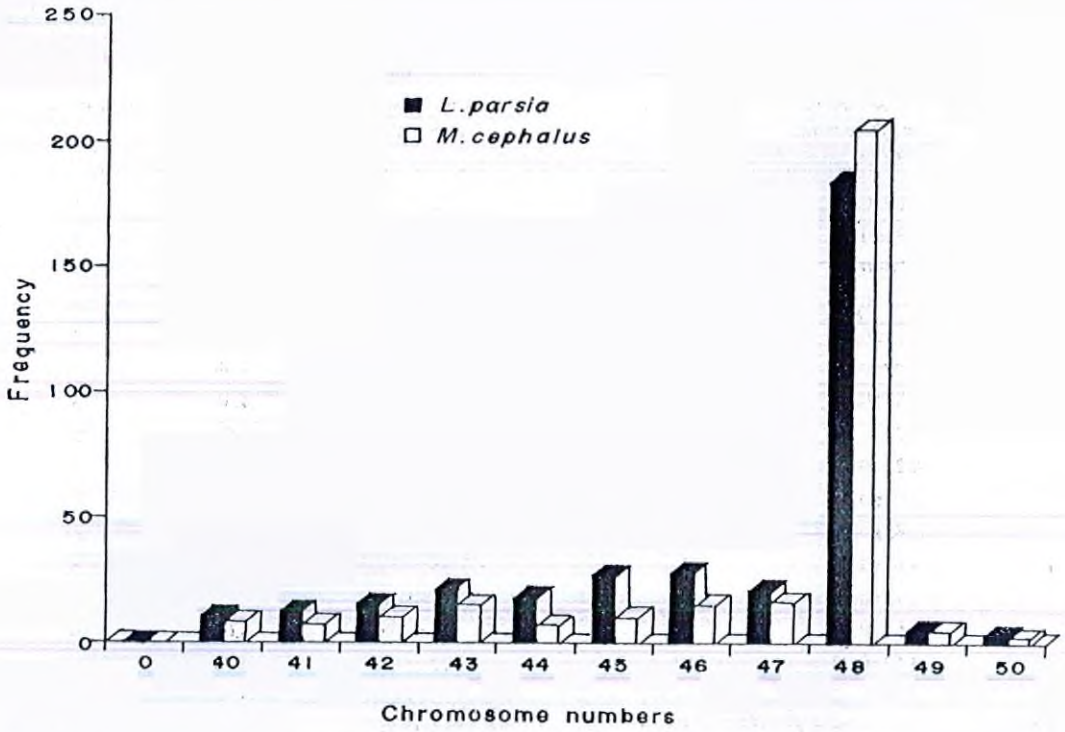


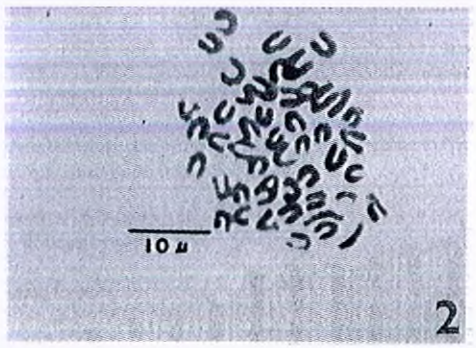
Fig. 1: Frequency of chromosome numbers in *L. parsia* and *M. cephalus*.

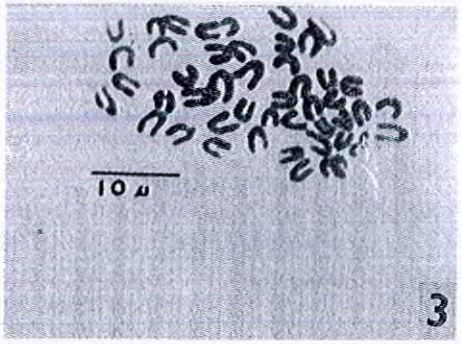
1976, Nayak & Kudha Bukhsh 1991). This uniformity of chromosome structure and number within the family Mugilidae is also suggested by the success with which many species will hybridize. Barker (1972) also suggested the same type of uniformity in the family Pleuronectidae. The tested species also showed a karyological similarities to other members of mullets except *M. curema* which showed a diploid number of 2n=28 with configuration of 10 pairs of metacentric, 2 pairs of subtelocentric and 2 pairs of acrocentric chromosomes (Le Grande & Fitzsimons 1976). Although different species may have the same karyotype (Booke 1968), this similarity observed here tends to support conspecific relationship as reported in galaxiid fishes by Mc Dowall (1967). A distinct karyological difference in the pairs 1,2 and 3 of both species are to be confirmed by further quantitative analysis. The chromosome complements of *Galaxias maculatus* from New Zealand differs from that of Australian and Chilean specimens (Merriless 1975). Such type of variations are not found in tested fishes (Indian mullets) in comparison with Mediterranean mullets having same diploid number and type of chromosomes, which support a genetic similarity of population of tested species from very distinct geographic regions. The karyotype with 48 acrocentric chromosomes is found throughout several diverse orders of subclass Teleostei (Class Osteicthyes) and seemed to be predominant karyotype in Perciformes (Robert 1964, 1967, Denton 1973, Chairelli & Capanna 1973) and this type of chromosomes could be considered primitive within many groups (Ebeling & Chen 1970, Vitturi & Catalano 1988). Hence, *L. parsia* and *M. cephalus* can also be considered as primitive member of Teleostei. Furthermore, these biarmed chromosomes are regarded as a derived state as reported in tetradontiform fishes by Arai & Nagaiwa (1976).

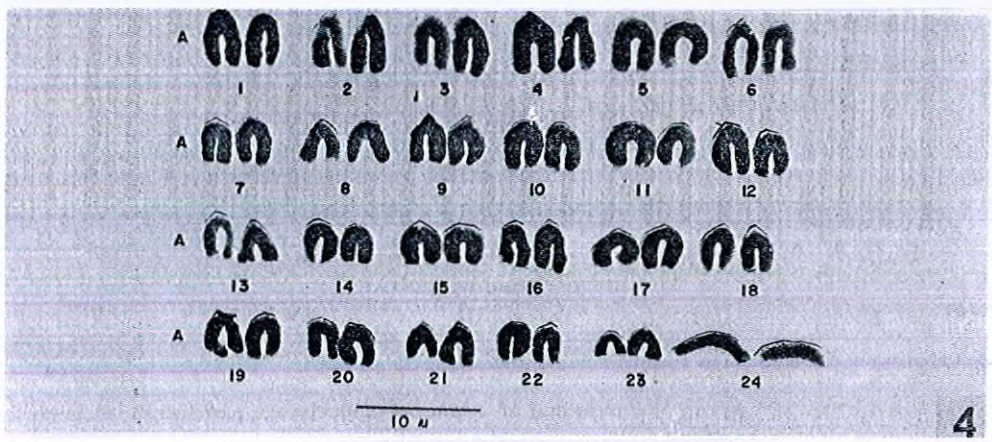
TABLE 1: Chromosome measurements and classification derived from metaphase cells of *L. parsia* and *M.cephalus*.

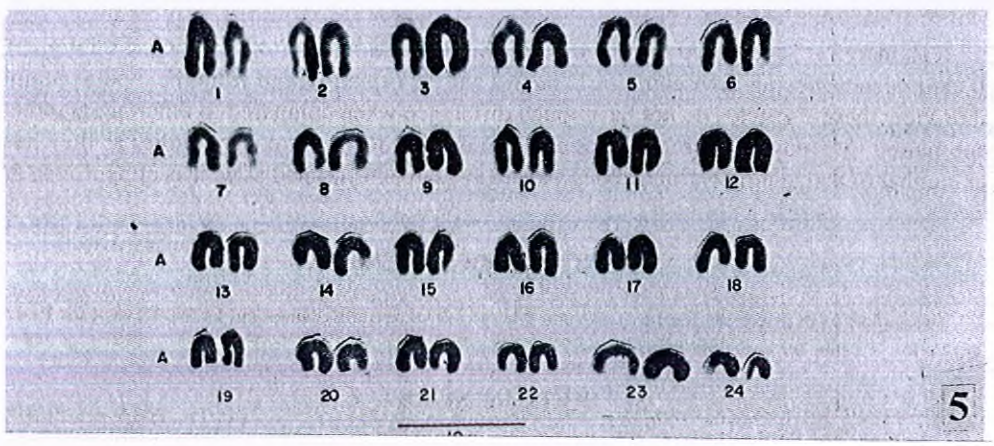
Chrom. pair	*L. parsia*		*M. cephalus*		Chromosome classification
	Chromosome length (µm) (x±S.D)	Relative length (%)	Chromosome length (µm)	Relative length (%)	
1	4.80±0.17	5.33	5.52±0.16	6.40	A
2	4.72±0.14	5.24	5.16±0.06	5.98	A
3	4.70±0.05	5.22	4.83±0.19	5.59	A
4	4.62±0.02	5.13	4.19±0.09	4.85	A
5	4.55±0.05	5.05	4.05±0.03	4.79	A
6	4.50±0.05	4.99	4.05±0.06	4.69	A
7	4.37±0.08	4.85	4.02±0.03	4.66	A
8	4.32±0.14	4.80	3.94±0.06	4.56	A
9	4.25±0.05	4.72	3.77±0.06	4.37	A
10	3.92±0.02	4.35	3.64±0.03	4.21	A
11	3.85±0.05	4.27	3.61±0.06	4.18	A
12	3.80±0.05	4.22	3.58±0.03	4.15	A
13	3.72±0.08	4.13	3.55±0.12	4.11	A
14	3.67±0.02	4.08	3.50±0.06	4.05	A
15	3.52±0.08	3.91	3.27±0.06	3.79	A
16	3.47±0.02	3.86	3.25±0.03	3.76	A
17	3.45±0.05	3.83	3.14±0.03	3.63	A
18	3.37±0.02	3.74	3.02±0.03	3.50	A
19	3.07±0.08	3.41	3.00±0.06	3.47	A
20	3.00±0.05	3.33	2.86±0.03	3.31	A
21	2.87±0.02	3.19	2.80±0.09	3.24	A
22	2.75±0.05	3.05	2.64±0.09	3.05	A
23	2.55±0.05	2.83	2.52±0.09	2.92	A
24	2.12±0.02	2.36	2.25±0.03	2.60	A

In the present study, colchicine of various concentrations (0.001, 0.01, 0.1, 0.5, 1.0%) was intramuscularly injected at the rate of 1ml/100g of body weight of fish for 2 and a half to arrest the metaphase. The best chromosome plates were obtained at a colchicine concentration of 0.01%, and shortening of the chromosome was observed beyond this concentration whereas in *M. corsula* and *M. parsia* best results were obtained with the administration of 0.1% colchicine intramuscularly at the rate of 2 ml/100 g body weight for 4 h exposure (Khuda Bukhsh & Manna 1976). This shows the action of colchicine may also depend on the tissue permeability and habitat of the species. Metaphase plate number per individual was found to be less when the colchicine exposure time was less. This may be due to incomplete action of colchicine. Number of metaphases was found to be higher when the fishes very actively swimmed after the colchicine injection. In the present taxa, all chromosomes are acrocentric as reported in previous studies, longest and shortest chromosomes range from 4.80 to









Figs 2-5 : Karyotypes of mullets . 2. Somatic metaphase of *L. parsia* 3. Somatic mataphase of *M. cephalus* 4. Karyotype of *L. parsia.* 5. Karyotype of *M. cephalus.*

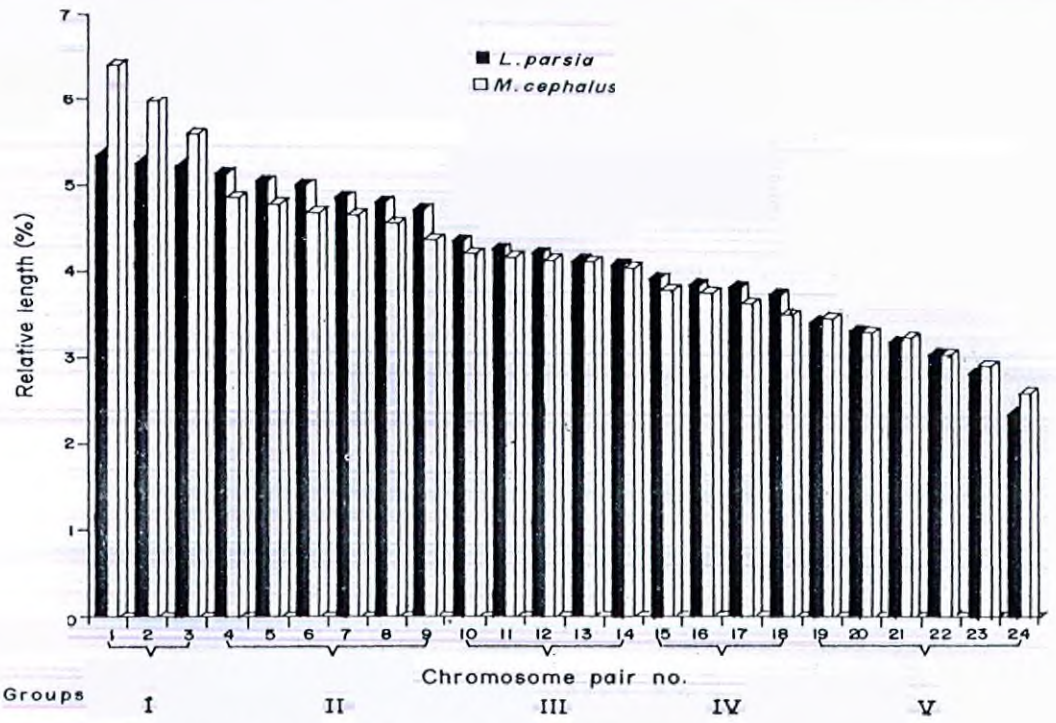


Fig 6 : Chromosome pair length in *L. parsia* and *M. cephalus.*

2.12 µm and 5.52 to 2.25 µm in *L. parsia* and *M. cephalus* respectively whereas in the case of *M. parsia* and *M. corsula* from the east coast of India, the length of chromosomes varied from 1.68 to 0.80 µm and 2.47 to 1.39 µm respectively (Khuda Bukhsh & Manna 1976).

It is, therefore, concluded that the diploid chromosome number of 2n =48 and configuration of all chromosomes being acrocentric in *L. parsia* and *M. cephalus,* and from the cytotaxonomical point of view these 2 species do not have much difference when compared to other geographically distant mullets. Moreover, these 2 species can also be used for genotoxicity studies as they have a lesser number of acrocentric chromosomes and are available in polluted as well as nonpolluted environments.

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