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KARYOLOGICAL STUDIES ON AFRICAN CATFISH, Clarias gariepinus (Burchell, 1822)

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ABSTRACT

Karyological studies on African catfish ***Clarias gariepinus*** *originating from the Egyptian inlandwaters (Lake Mariut) have been done to determine if it reveals an identical karyotype to the other strains of this species or not . The diploid chromosome number was found to be 56 chromosomes, length ranged from 1.70 to 6.90 µm, the total length of the chromosome set was 105 µm. Fundamental number for male and female were 88 and 87 respectively. The modal karyotype for male consisted of 14 metacentric, 18 submetacentric and 24 acrocentric chromosomes while that of female revealed 14 metacentric, 17 submetacentric and 25 acrocentric chromosomes. These differences in morphological distribution of the karyotype between male and female were attributed to the sex determination of this species belong to the ZZ - ZW system i.e. female karyotype contains a large submetacentric chromosome and a small acrocentric chromosome as compared to that pair of submetacentric chromosomes in male.*

INTRODUCTION

Comparative studies on karyotypes have significantly contributed to the solution of taxonomic and evolutionary problems for closely related species groups. The taxonomy of African ***Clarias*** species has been extremely confusing for a long time. Teugels (1982, 1984, 1986) gave a new systematic revision of the African catfish species of genus ***Clarias***. He reported that ***C. lazera***, ***C. gariepinus*** and ***C. mossambicus*** are synonyms for one species which is ***Clarias gariepinus***.

The identification given by that author was based merely on the geographic origin of the specimens. Teugels synonymy relied on the results of a comparative morphological and osteological studies of populations sampled in different tropical African localities and biological study of populations obtained from Israel and Southern Africa.

Ozouf - Costaz, ***et al.*** (1990) studied the chromosome sets of three strains of the African catfish (***C. gariepinus***) from Israel, Ivory Coast and Central African Republic in order to check up the synonymies between ***C. gariepinus***, ***C. lazera*** and ***C. mossambicus***, their studies did not include catfish samples obtained from River Nile countries, so this paper deals with the karyological analysis of African catfish from the Egyptian inlandwater to compare it with those from other geographical origins.

MATERIAL AND METHODS

Fifteen specimens of catfish, ***Clarias gariepinus*** collected from Lake Mariut in May 1995 were used for karyological analysis. Dorsal injection of 0.01 ml/g body weight colchicine solution were carried out. After six hours tissue of anterior kidney (maximum weight 0.1g) were prepared for hypotonic treatment and fixed according to the method of Foresti, ***et al*** (1992). Slide were cleaned and kidney tissues were divided into smaller parts and carefully squashed, after drying all preparations were stained for 25 minutes with 1% aceto - orcein solution. Well spread metaphases were selected and photographed, for establishing the karyotypes. The best photographs were used for cutting out, pairing and classifying chromosomes in decreasing sizes.

The indices of the arm ratio, the total length of the chromosome set, the relative length of the chromosome and the centromeric index were calculated. The Levan's nomenclature was used for the chromosome type presentation (Levan ***et al.***, 1964).

RESULTS

The karyological data characteristic of ***Clarias gariepinus*** was shown in Table 1. The diploid chromosome number of this species was 56, The morphology of chromosome set was characterized by homologous chromosome pairs of 6.90 - 1.70 μm length range. The total length of the chromosome set was 105 μm. The arm ratio reached up to 2.91 and the centromeric index ranged between 0.00 and 43.0 .

The karyotype of ***C. gariepinus*** (Figure 1) has seven metacentric chromosome pairs (3, 4, 5, 6, 7, 12 and 17), nine submetacentric chromosome pairs (1, 2, 8, 9, 13, 15, 16, 18 and 20) and twelve pairs of acrocentric chromosomes (10, 11, 14, 19, 21, 22, 23, 24, 25, 26, 27 and 28).

Also the results showed that female karyotypes revealed the presence of differentiated sex chromosomes a large submetacentric and a small acrocentric ones while male karyotype contained a pair of submetacentric sex chromosomes. (Figure 2,3).

The modal karyotype of male consisted of 14 metacentric chromosomes (m), 18 submetacentric chromosomes (sm) and 24 acrocentric chromosomes (a), the fundamental number (NF) was 88. The modal karyotype of female consisted of 14 metacentric chromosomes, 17 submetacentric chromosomes and 25 acrocentric chromosomes. The NF value was 87.

DISCUSSION

Ozouf - Costaz *et al.* (1990) studied the chromosome sets of catfish, ***Clarias gariepinus*** from different geographical origins, where samples were obtained from Israel, Ivory Coast and Central African Republic. On comparing the chromosome set of catfish sampled from Egyptian inland water, it can be observed that Egyptian catfish showed the same chromosome number (2n = 56).

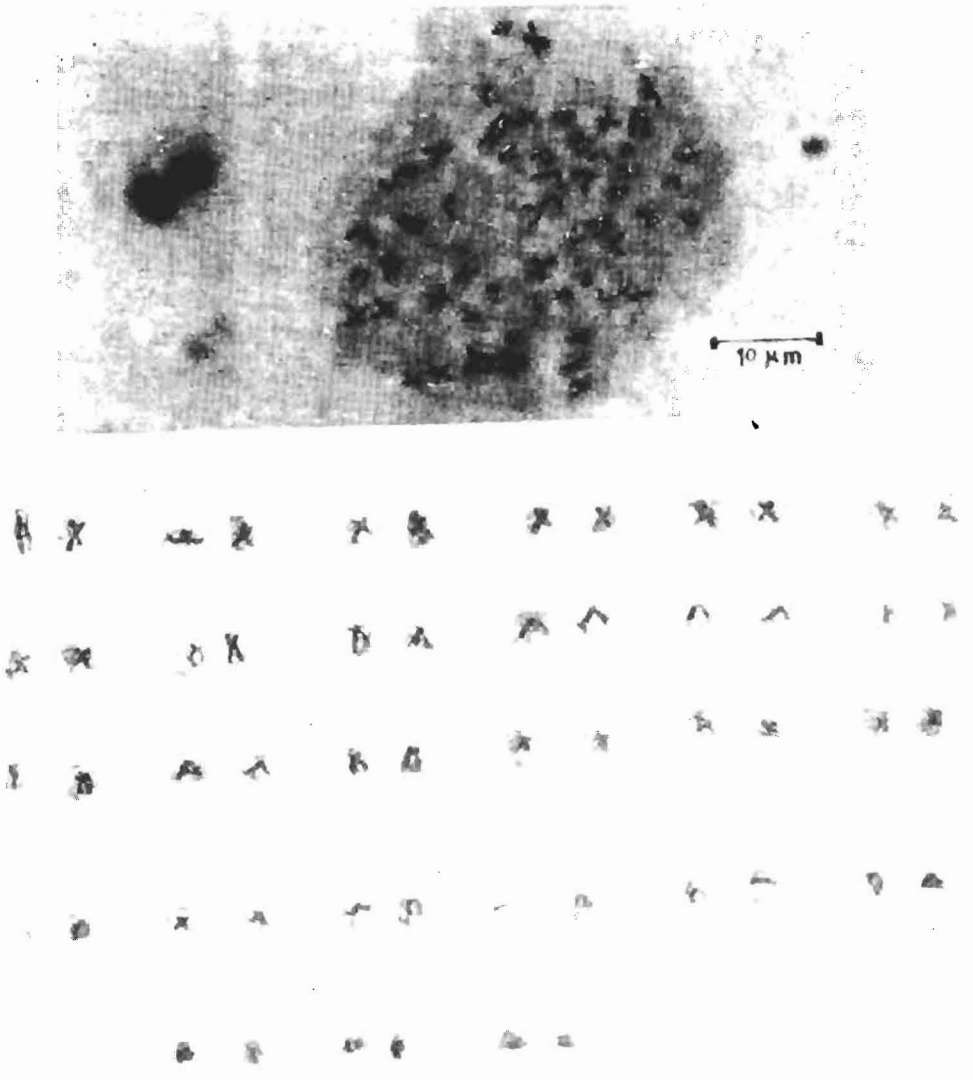

Fig 1. Somatic chromosome spread and karyotype of male of Clarias gariepinus (2n = 56)

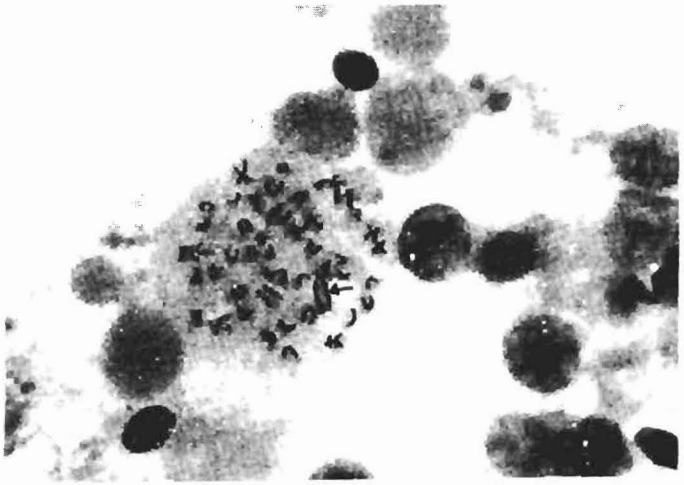

Fig 2. Somatic chromosome spread of male of Clarias gariepinus (NF = 88), arrow showsthe submetacentric sex chromosome.

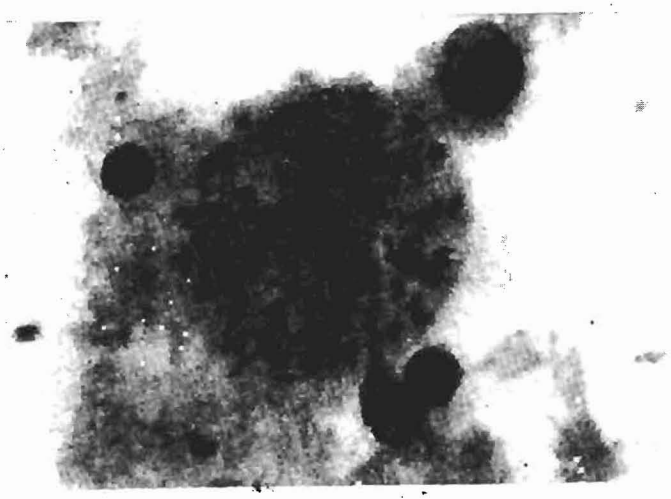

Fig 3. Somatic chromosome spread of female of Clarias gariepinus (NF = 87)

Table (1) : Indices of a karyotype of African catfish, ***Clarias gariepinus***.

Type	-eric index	Total length %	Total length mμ	Arm ratio	Length of short arm mμ	Length of long arm mμ	Chromo-some No.
s.m	29	6.57	6.90	2.45	2.00	4.90	1
s.m	31	5.52	5.80	2.22	1.80	4.00	2
m	41	4.86	5.10	1.43	2.10	3.00	3
m	40	4.76	5.00	1.50	2.00	3.00	4
m	40	4.71	4.95	1.48	2.00	2.95	5
m	40	4.52	4.75	1.50	1.90	2.85	6
m	38	4.48	4.70	1.61	1.80	2.90	7
s.m	33	4.29	4.50	2.00	1.50	3.00	8
s.m	26	4.10	4.30	2.91	1.10	3.20	9
a	0.0	4.00	4.20	—	0.00	4.20	10
a	0.0	3.91	4.10	—	0.00	4.10	11
m	43	3.48	3.65	1.36	1.55	2.10	12
s.m	34	3.48	3.65	1.92	1.25	2.40	13
a	0.0	3.48	3.65	—	0.00	3.65	14
s.m	37	3.19	3.35	1.68	1.25	2.10	15
s.m	34	3.19	3.35	1.91	1.15	2.20	16
m	40	3.10	3.25	1.50	1.30	1.95	17
s.m	36	2.91	3.05	1.77	1.10	1.95	18
a	0.0	2.86	3.00	—	0.00	3.00	19
s.m	35	2.86	3.00	1.86	1.05	1.95	20
a	0.0	2.81	2.95	—	0.00	2.95	21
a	0.0	2.76	2.90	—	0.00	2.90	22
a	0.0	2.76	2.90	—	0.00	2.90	23
a	0.0	2.76	2.90	—	0.00	2.90	24
a	0.0	2.71	2.85	—	0.00	2.85	25
a	0.0	2.57	2.70	—	0.00	2.70	26
a	0.0	1.76	1.85	—	0.00	1.85	27
a	0.0	1.62	1.70	—	0.00	1.70	28

m = metacentric s.m = submetacentric a = acrocentric

The morphological distribution of the male karyotype was found to be different in the number of metacentric and submetacentric chromosomes but it revealed the same number of chromosome arms (NF=88). The morphological distribution of the karyotype and fundamental number of female were different. Chromosome length range and the total length of the chromosome set could not be compared for lacking of these data for the three mentioned strains.

Sex determination in fish species revealed many cases of heterogamety involving different types. XX/XY type was given for ***Salmo gairdner*** (Thorgaard, 1977), for ***Leporinus lacustric*** (Galetti *et al.*, 1981) and for ***Coris jutis*** (Duchac *et al.*, 1982), XX/XO type for ***Symphurus plagiusa*** (Le Grande, 1975), ZZ/ZO type for ***Colisa fasciatus*** (Rishi, 1979), XXXX/XXY for ***Oncorhynchus nerka*** (Thorgaard, 1978), ZZ/ZW type for family ***Anguillidae*** (Park & Kang, 1976 and Passakas, 1981) and for ***Cynoglossus puncticeps*** (Patro and Prasad, 1981). However, studying sex determination in catfish indicated that type XX/XY was found in ***Prectostomus anestrbes*** which inhabit South America (Michele *et al.*, 1977) and North American catfish ***Noturus taylori*** (Le Grande, 1981).

The present work revealed that ZZ - ZW mechanism has been observed in ***C. gariepinus***. This agrees with the finding of Ozouf - Custaz *et al.* (1990) but it differs only in the chromosome type of male which has a pair of submetacentric chromosomes as compared to a pair of small acrocentric chromosomes in his study.

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REFERENCES

Duchac, B.; F. Huber; Mueller and D. Senn, 1982. Mating behaviour and cytogenetical aspects of sex inversion in the fish ***Coris julis***. (***Labridae*** : Teleostei). Experientia, 38(7) : 809 - 810.

Forest, F.; C. Ozouf - Costaz and P. Rab, 1992. Volume dependent effect of hypotonic treatment on good spreading of fish chromosomes. Cybium,16(3): 209 - 212.

Galetti, P.M.; F. Foresti; L.A.C. Bertollo and F. O. Moreira, 1981. Heteromorphic sex chromosomes in three species of the genus ***Leporinus*** (Pisces, ***Anostomidae***). Cytogenet. Cell. Genet., 29(3): 138 - 142.

Le Grande, W.H., 1975. Karyology of six species of Louisiana flatfishes (***Pleuronectiformes*** : Osteichthyes) . Copeia, 3:516 - 522.

Le Grande, W.H., 1981. Chromosomal evolution in North American catfishes (***Siluriformes*** : ***Ictaluridae***) with particular emphasis on the madtoms, Noturus. Copeia, 1: 33 - 52.

Levan, A.; K. Fredga and A.A. Sandberg, 1964. Nomenclature for centromeric position on chromosomes. Hereditas, 52: 201 - 220.

Michele, J. L. ; C. Takahashi and I Ferrari, 1977. Karyotype study of some species of the family ***Loricaridae*** (Pisces). Cytologia, 42 (3 - 4): 539 - 546.

Ozouf - Costaz, C. ; G. G. Teugels and M. Legendre, 1990. Karyological analysis of three strains of the African catfish, ***Clarias gariepinus*** (***Clariidae***), used in Aquaculture. Aquaculture, 87: 271 - 277.

Park, E. H. and Y. S. Kang, 1976. Karyotype conservation and difference in DNA amount in anguilloid fishes. Science, 193 (4247): 64 - 66.

Passakas, T., 1981. Comparative studies on the chromosomes of the European eel (***Anguilla anguilla***) and the American eel (***A. rostrata***). Folia biol., 29(1) : 41 - 57.

Patro, R. and R. P. G.Prasad, 1981. Chromosomal studies in five Indian flatfishes. Copeia, 2: 498 - 503.

Rishi, K. K., 1979. Somatic G- banded chromosomes of ***Colisa fasciatus*** (***Perciformes***; ***Belonidae***) and confirmation of female heterogamety. Copeia, 1: 146 - 149.

Teugels, G. G., 1982. Preliminary results of a morphological study of the African species of the subgenus ***Clarias*** (***Clarias***) (Pisces, ***Clariidae***). J. Nat. Hist. , 16: 439 - 464.

Teugels, G. G.,1984. The nomenclature of African ***Clarias*** species used in aquaculture. Aquaculture, 38 (4): 373 - 374.

Teugels, G. G., 1986. A systematic revision of the African species of the genus ***Clarias*** (Pisces, ***Clariidae***). Ann. Mus. R. Afr. Centr., 247:199 pp.

Thorgaard, G. H., 1977. Heteromorphic sex chromosomes in male rainbow trout. Science, 196 (4292) : 900 - 902.

Thogaard, G. H ., 1978. Sex chromosomes in the sockeye salmon: a Y - autosome fusion. Can. J. Genet., 20(2) : 349 - 354.