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Original Article

Temperature induced chromosomal changes in Indian catfish *Heteropneustes fossilis*

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Abstract

The effect of sudden exposure to temperature on the chromosomal morphology of Indian catfish *Heteropneustes fossilis*, 15 days after fertilization young ones were exposed to five different higher temperature namely 37,38, 39, and 40°C for a period of four hours. Chromosome spread of the fish from each experiment was prepared and results were documented. The fish when exposed to higher temperatures resulted in chromosomal aberrations such as deletion and translocations. The intensity of chromosomal aberration was more in fish exposed to the highest temperature of 40°C, when compared to other temperatures exposed.

Key words: *Heteropneustes fossilis*, Chromosome, Cytogenetics, Temperature

Introduction

Cytogenetics is very important tool in studying pollution related chromosomal aberration, *viz* deletion, inversion and translocations. The first two affect only single chromosome whereas translocations may involve one or two or more chromosomes. The detection can be made both cytologically and genetically in favourable material or in less favourable materials. Certain aberrations can be inferred from the chromosomes configuration found at metaphase and anaphase of meiosis 1.

Heat shock during the paring may produce both asynapsis and desynapsis (Loidl, 1989). This is turn, any alter the subsequent orientation and segregation behaviour through an effect of sister chromatid cohesion. Most of the chromosomal aberration studies were carried out in animal exposed to certain chemical or industrial effluents in order to study the genotoxicity. But heat exposure effects of chromosomal aberration studies are very few. Hence in the present study the effect of temperature on the changes in chromosomal morphology in Indian catfish, *Heteropneustes fossilis* was carried out.

Materials and Methods

The Indian catfish, *Heteropneustes fossilis* brooders were collected and were transported to the laboratory. They were maintained in freshwater in 100liter capacity fibre glass tanks. The temperature during the acclimation period was 28 ± 0°C and dissolved oxygen of the ambient water was maintained above 50% air saturation. They were breed controlled laboratory conditions and their 15 days after fertilization young ones were used in the present study. The young ones were reared in the laboratory prior to experiment. They were fed with formulated diet having groundnut oil cake, rice bran and fish meal supplemented with vitamin mix and minerals (Sukumaran, 1985). In this experiment four groups of fish exposed to four different temperature 37, 38, 39, 40 and 41°C for a period of four hours in order to study the effects of sudden exposure to higher temperature on the chromosome of this important culturable species.

Healthy 15 days after fertilization young ones exposed to 37, 38, 39 and 40, °C in 4 different aquarium tanks for four hours. After 4 hours, the fish were taken and injected 0.05% of colchicines allowed swimming for 3 hrs in aerated water. After 3hrs, kidney and gill tissues were removed for chromosome preparation as described by Ponraj and Sukumaran, (1999). The tissues were kept in 0.8% of Trisodium Citrate for hypotonization for 50min. Then the tissues were transferred to Carnoy's fixative for 5 min with 3 different changes. The cells were again kept in 50% acetic acid. The cell suspensions

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were dropped in to the slide kept in 50°C in histoplate. The slide was air dried and kept in 4% Giemsa's buffered solution for 30min. Then the slide was washed in running water and air dried. The well prepared slide was observed under the microscope for chromosomal observation.

Results and Discussion

The chromosome spread of control fish observed that the arms of the chromosomes are clearly visible and long arm and short arms are distinct. The arms are correct in length. The relative size of the chromosome ranged from 2.5-4.3 mm and 1.5-3.5 mm respectively as described by Levan *et al.*, (1964). The diploid number of chromosome of *H. fossilis* was observed 58 (Fig.1). This comprises of 9 pairs of metacentric, 6 pairs of submetacentric, 6 pairs of subtelocentric and 8 pairs of acentric chromosome.

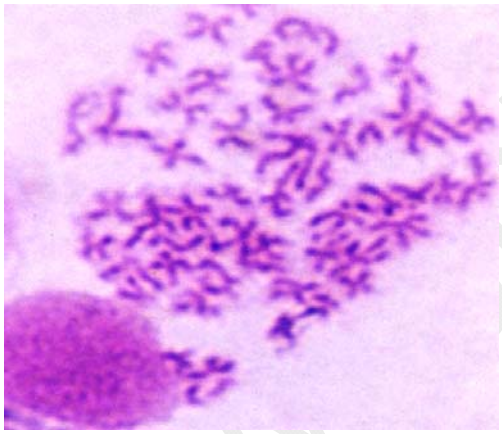

Fig.1: Chromosome spread of fish exposed at 39°C

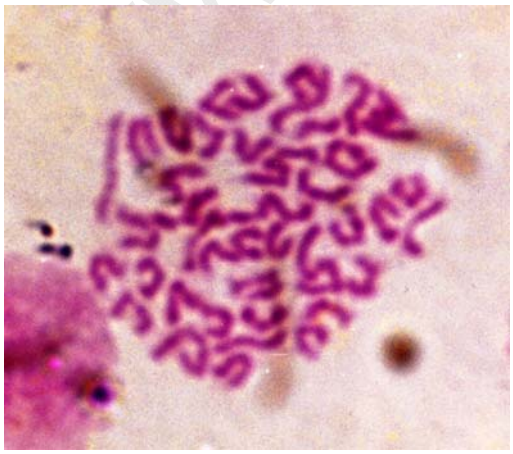

Fig.2: Chromosome spread of fish exposed at 37°C.

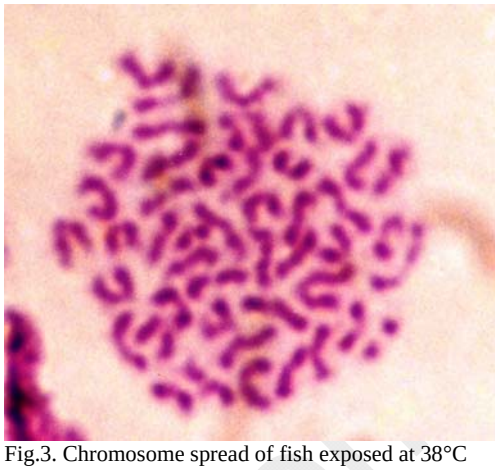

Fig.3. Chromosome spread of fish exposed at 38°C

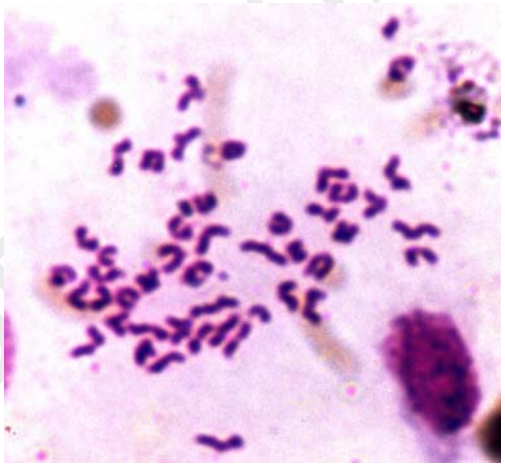

Fig.4: Chromosome spread of fish exposed at 39°C

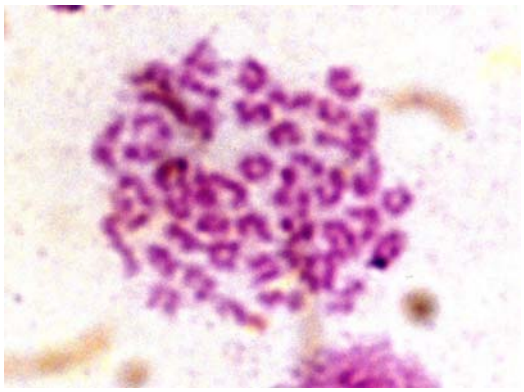

Fig.4: Chromosome spread of fish exposed at 39°C

The chromosome spread of *H. fossilis* exposed to 37°C and 38°C (Fig.2 & 3) for a period of 4 hrs is given, which clearly indicates that the chromosome arms are thread like and there is no differentiation of long and short arm. It is also noted that the arm length and structure

of few chromosome was found to be too long indicating the deletion of the arms of some of the chromosomes and subsequently they were attached to other chromosomes resulting in longer arms. In some of the cases centromere was also found to be missing and chromosomes became curved in nature.

The chromosome spread of Indian catfish exposed to 39°C (Fig.5) noted that among the chromosomes, there is no differentiation of long arm observed that the arm length is found to be longer in some of the chromosome, when compare to control chromosome. It is interesting to note that some of the chromosome pairs are irregular in shape suggesting that the temperature exposure resulted in chromosomal aberrations and also few of the chromosomes were missing.

The chromosomal spread of Indian catfish *H. fossilis* exposed to 40°C (Fig.5) indicates that all the deleterious effect described above were found in this case but it is noted that the severity of chromosomal aberration was found to be more possibly due to the higher ambient temperature (40°C). This is almost near to incipient lethal temperature. It is noted that chromosome are split in to smaller bits indicating more number of deletions.

In this study it is observed clearly that though the temperature exposure at all the four temperature resulted in chromosomal aberrations such as deletions and translocations as observed in the case of fishes exposed to other pollutants like pesticides and industrial effluents (Ponraj et al, 1999). The intensity of the effect increased with increase in ambient temperature. This may be possibly due to exposure of catfish to the incipient lethal temperature level.

Conclusion

Though this study did not provide adequate information on the exact changes in the chromosome of Indian catfish, further detailed study on this line will enlighten the exact effect of temperature on the chromosome structure of poikilotherms.

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