



Short Communication

Cypermethrin exposed chromosomal aberrations of Indian major carp, *Labeo rohita*

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Abstract

With the beginning of Green Revolution in the second half of the 20th century when growers initiated to use technical advances to enhancement harvests, manmade composts, pesticides and herbicides became common place from place to place the world not only on farms but in courtyard greens and on front lawns as well. Among the wide majority of pesticides, Cypermethrin, a synthetic pyrethroid, is regularly used as agronomic insecticide which is found tremendously lethal to non-target creatures of aquatic habitat including fishes. As per statistic, manufacture and efficiency have amplified. Though, the high biochemical practices of insecticides to carry around these remarkable upsurges in nutriment manufacture is not without its glitches. A perceptible similar association amongst advanced efficiency, high chemical contribution usage and ecological dilapidation possessions is apparent in south Gujarat where marketable cultivation is extensive. This affects the physiological and cytological changes among the fishes. With that reference Cytogenetic study of *Labeo rohita* has been carried out to check effects of lethal concentration (0.06ppm) and acute lethal concentration (0.1ppm) of Cypermethrin. The chromosomal aberrations like acentric fragments, rings, double minutes and chromosome break, endo-reduplication, premature separation of chromosome and pulverization were observed at various stages.

Keywords: Chromosomal Aberrations, Cypermethrin, Rohu.

Introduction

Water pollution has emerged as one of the most burning tribulations of this century. The pollution of aquatic ecosystems occurs globally includes an assortment of sources, impacts and is escalating. No other natural resource is more contested than water. Water pollution has been variously distinct commonly involves deprivation follow-on from human actions that cause water to become impracticable for an intended function. It is imperative to differentiate the effects of human actions from natural phenomena, e.g. mud slides, volcanic eruptions etc. natural phenomena signify forces which essentially figure the advancement of natural ecosystems in the dearth of human action. Water pollution linked with anthropogenic activities is characteristically brisk and outstrips the evolutionary potential of ecosystems, leaving them in a deplete state. Through the beginning of Green Revolution in the second half of the 20th century when agriculturalists initiated to usage high-tech advances to increase crop's production, artificial nourishments, pesticides and herbicides converted communal residence everywhere the ecosphere not only on farms but in courtyard, grounds and on obverse grasses as well. These compounds remained established in the laboratory and are petroleum-based consume permitted agriculturalists and horticulturists of each hoop to work out better regulator finished the floras they want to cultivate by elevating the instantaneous atmosphere and warding off vermin. Nonetheless such assistances haven't derive

deprived of ecological prices specifically the comprehensive effluence of most of our watercourses, creeks, pools, lagoons and even littoral zones, as these artificial compounds overflow hooked on the adjacent watercourses. When the superfluous nutrients meanwhile all the fertilizers we consumption, run off into our watercourses, they reason algae blossoms occasionally large sufficient to create water course impenetrable. When the algae perish, bowl to the bottommost and crumble in a procedure that eradicates oxygen commencing the water. Fish and supplementary aquatic sorts can't endure in these ostensible "dead zones" therefore they pass away or else exchange on to emerald submerged meadowlands. The associated matter is the exterminating of aquatic life. Cultivated water contamination is triggered by dint of manures, insecticides, farmstead animal trashes and residues. Examination verdicts designate that solicitation and dense dosages of nourishments spoil the water over percolating of nitrate from nitrogenous fertilizers and pesticides. The use of numerous forms of pesticides and insecticides in farming effect water pollution. Death of aquatic animals has been reported due to application of pesticides¹ is known to be hazardous. Even though around are assistances in the usage of pesticides, there are similarly disadvantages, such as probable noxiousness to hominids and further faunas. Rendering to the Convention of Stockholm on determined Carbon-based Impurities, 10 of 12 most precarious and stubborn organic chemical are pesticides². Agreeing to Agnihotri³, the decline in Cypermethrin aqueous quintessence was prompt, with

about 95% vanished surrounded by 24 hours afterward application to water and remains enclosed in open dugouts. Decline in attentiveness was principally owing to hasty sorption to sediment and adjourned constituent part and not deprivation. The divider measurement of Cypermethrin is very high ($K_{ow}=3.98 \times 10^6$), subsequently it quandaries powerfully onto organic matter⁴. For the reason that its durable kinship for soil, Cypermethrin may be voted for away to nearby water forms in adjourned deposit by rain and irrigation. Up till now, once the pesticide was adsorbed to soil particles, bioavailability was cheap, lessening the toxicological jeopardy to aquatic faunas. In mere experimentations, fish had persisted in pond water that confined seemingly mortal deliberations of cypermethrin (5 ppb) because the chemical was moaned against suspended solids.

As per statistic, assembly and efficiency have enlarged. Though, in elevation chemical usage of pesticides to fetch almost these enormous intensifications in foodstuff fabrication is not deprived of its complications. A perceptible or responding relationship amongst higher efficiency, high chemical involvement and ecological poverty possessions is manifest in south Gujarat where commercial agriculture is extensive. Crops like rice, maize, jowar, cotton, banana, mangoes, cheeku, pomegranate and all types of vegetables are grown in south Gujarat to get more production farmers use various types of pesticides. Cypermethrin is most commonly used pesticide which is used as an insecticide. With this component the water runoffs into Tapi river and affect the health of aquatic organisms including fishes.

Therefore contemporary exertion is intended to appraise the noxious effects of widely used pesticide, Cypermethrin on a commercially important fresh water fish *Labeo rohita* locally known as Rohu. It is one of the major carps, column feeder and widely accepted for its delicate taste. Fish corresponds to a good cytogenetic model⁵. Disproportionate levels of Cypermethrin once made obtainable to the aquatic environment are not frequently uninvolved quickly or are willingly detoxified by metabolic activity, as a result they build up in the organisms present in the water and may cause mutagenic effects by altering structure of DNA leading to genetic effects which may reflect in chromosome as chromosomal aberrations. Thus chromosomal study has also been undertaken.

Materials and methods

Present study was conducted to appraise the toxicity of Cypermethrin on fresh water edible fish *Labeo rohita*. Experiments were carried out to check the endurance of fish and damage caused in cytogenetic studies. Healthy and active fresh water fish *L. rohita* having weight of 8 ± 2 gm and size of 9 ± 2 cm were procured from the Krishna Fisheries, Sayan village of Surat district, India. Before investigation fish were maintained at least for 10 days in large glass aquaria containing chlorine free tap water. Totally aquaria were retained in the laboratory in

cool place and covered with nets to prevent the escape of animals and the foreign particles falling in. Dead specimens were removed immediately. Water was reintroduced all time and fish nourished daily by dint of commercial dried feed pellets and fine powder of rice bran and oil cake.

Cypermethrin (10% EC) was obtained from Heranba Industries Limited, Vapi, Gujarat, India and used to check its impact on fish.

The modified method of Ojima⁶ was adopted to prepare metaphase chromosomes. Fishes were injected with 0.02% colchicine intraperitoneally. After 2 hrs gills of the fishes were taken out for hypotonic treatment (0.56% KCL). After using the fixative (Methanol + Acetic acid, 3:1), air desiccated preparation of slide was carried out. Slides were blemished with 4% Giemsa and were observed under oil immersion objective.

Photomicrographs for cytogenetic observations were taken on trinocular microscopes (Olympus CX41, Nikon Eclipse E600). All the experiments were repeated atleast thrice.

Results and discussion

The normal fish metaphase plate is shown in Figure-1. However in karyotype the chromosome sets 1 to 5 be made up of middling centromere are the metacentric chromosomes. The chromosome sets 6 to 13 having sub-middling centromere are the sub-metacentric chromosomes. The chromosome sets 14 to 25 by incurable centromere are acrocentric chromosomes (Figure-2).

The exposure to lethal treatment brought various types of chromosomal aberrations such as acentric fragments (Figure-3), rings (Figure-4), double minutes and chromosome break (Figure-5), endo-reduplication (Figure-6), premature separation of chromosome (Figure-7) were observed at various stages. The exposure to acute lethal treatment brought various types of chromosomal aberrations like rings (Figure-4), and pulverization (Figure-8) were also observed at various stages.

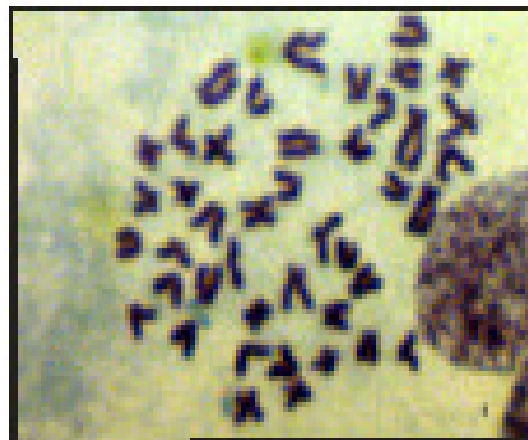


Figure-1: Normal metaphase chromosome of *L. rohita*.

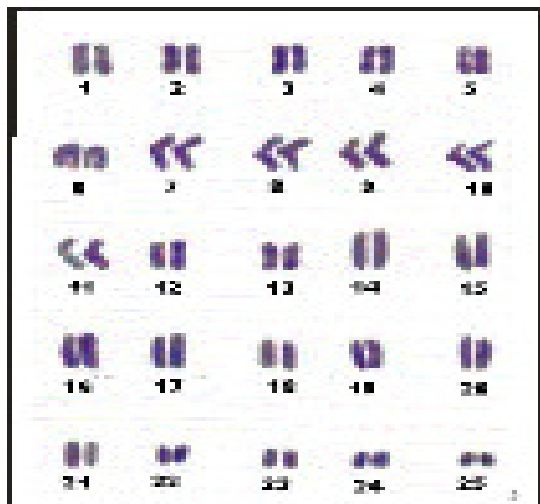


Figure-2: Karyotype of fish (*L. rohita*) chromosome.

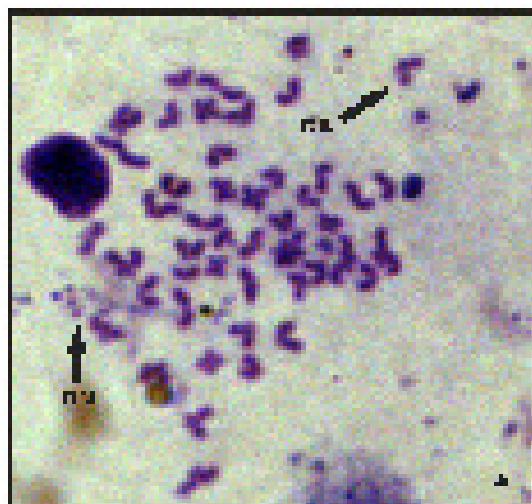


Figure-5: Chromosomal break (CB) and double minutes (DM).



Figure-3: Acentric fragment (AF) after exposure to lethal Concentration.

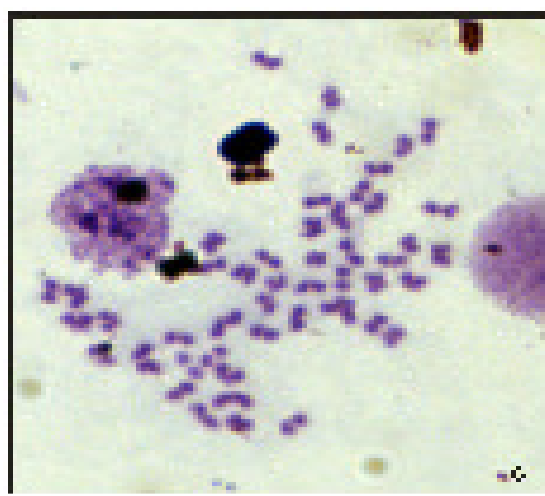


Figure-6: Endo-reduplication configuration after exposure to lethal Concentration.

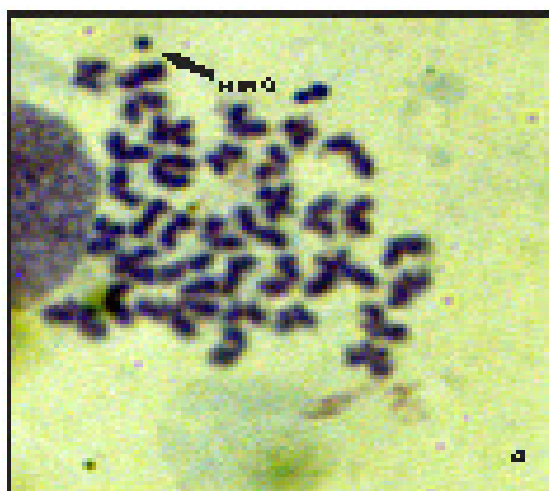


Figure-4: Ring chromosome after exposure to lethal concentration.

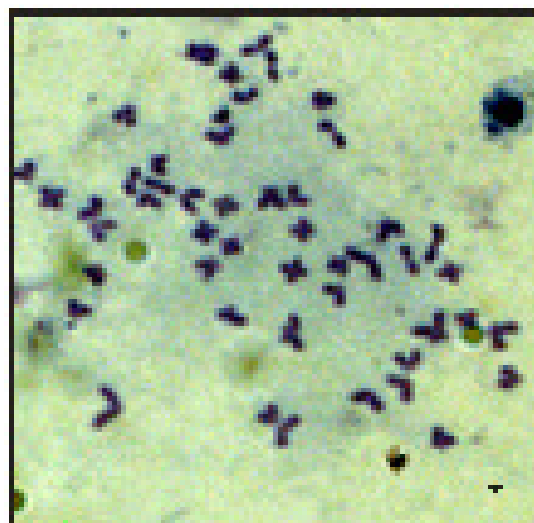


Figure-7: Premature separation of chromosome (PSC).

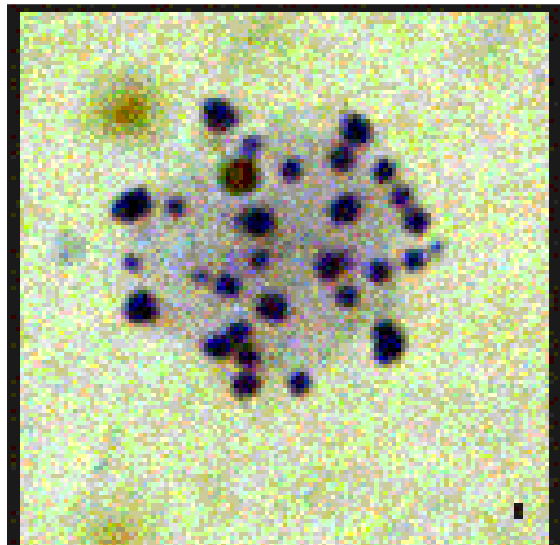


Figure-8: Pulverization in acute lethal concentration.

Discussion: Pyrethroids are favored upstairs carbamates, organophosphates and organ chlorines by way of these partake extraordinary effectiveness, stumpy noxiousness and laid-back biodegradability⁷. Aimed at further 30 years, pyrethroids are in use for homegrown inventions and agronomic determinations and these insecticides concealment approximately one-fourth of the universal arcade⁸. In the latter epoch, their use has been amplified⁹. Cypermethrin, man-made pyrethroid, lipophilic in natural surroundings, is well thought-out to be in a smaller amount lethalowed to its immediate creepy-crawly assassination possessions and having little toxicity to mammalian fleshes¹⁰. Yet, it is temperately toxic when applied dermally or directedverbally¹¹.

In the valuation and assessment of the toxic individualities of a constituent, willpower of noxiousness is frequently preliminary phase. It be responsible for evidence on healthiness perils prospective to ascend from petite stretch exposure. It is conventionally a step in founding a prescribed amount routine in further lessons by provided that preliminary statistics on the approach of toxic exploit of a stuff. *Labeo rohita*'s karyo type has been premeditated by various observers¹²⁻¹⁴. All these scientists have described the diploid numeral (2n) in these two sorts as 50. In Catla, the karyotype entailed of 12 metacentric, 16 sub metacentric, and 22 sub-telocentric chromosomes. In Rohu, the karyotype bestowing to these writers resided of 10 metacentric, 18 submetacentric and 22 sub-telocentric chromosomes. Later observation with esteems to proportional karyotype of these carps also more-or-less approved. Krishnaja and Rege¹⁵ have also shown a substantial increase numeral of chromosomal abnormalities in *B. dussumieri* by Mitomycin-C, Hg, Se and Cr compounds. Gadhia¹⁶ reported effects of Cadmium Nitrate on metaphase chromosome of common carp *Cyprinus carpio*. Hence chromosomal aberrations and micronuclei test provide record of damage in genetic material which is very significant to access the toxicity of water and

heredity is poorly understood. Chromosomes are made up of genetic material present in the cell. Hence the damage in chromosomes is very important tool to study the damage in chromatin material at molecular level. 0.01ppm concentration of Dichlorvos instigated chromosomal peculiarities in the form of chromatid gaps, sub-chromatid breaks, attenuation, chromatid breaks, extra fragments, pyknosis, stubbed arms, centromeric gaps etc. in kidney cells of *Channa punctatus* later acquaintance epochs of 24, 48, 72 and 96hrs¹⁷. Stimulatingly, there was converse association amongst extent of abnormality regularity and exposure. The Thiocarbamate pesticide malinate and vernolate have been well-versed to cause fluctuations comparable SCE (sister-chromatid exchange) and chromosomal aberrations in vitro and amplified manifestation of polychromatic erythrocytes in mouse bone marrow cells¹⁸. Dissimilar aberrations of chromosome, such as rings, dicentric chromosomes and breaks, have been distinguished in kidney cells after the inoculation of three fish species (common carp, *Cyprinus carpio*, grass carp, *Ctenopharyngodon idella*; tench, *Tinca tinca*) with aflatoxins B, aroclor 1254, benzidine, benzo [a] pyrene and 20-methylcholanthrene^{19,20}.

Das²¹ appraised the special effects of two organophosphorus pesticides, phosphamidon and methyl parathion on *Etrophus suratensis* consuming chromosomal abnormalities by way of the genotoxicological examination instrument. Cypermethrin also meaningfully diminished the level of nucleic acids in the numerous fleshes of the fish *C. fasciatus*. The present work also showed that the Cypermethrin generally possessed the specialized chemical properties which facilitated their interaction with nucleus and effect the DNA molecule and resulted in genotoxic effects in the form of chromosomal aberrations like acentric fragments, rings, chromosomal break, double minutes, endo-reduplication, premature separation of chromosome and pulverizations.

Conclusion

Present study was undertaken to assess the effect of globally and regionally used pyrethroid insecticide, Cypermethrin on a non-target organism commercially important edible, fish *Labeo rohita* with reference to its cytogenetic observations. Findings of the work, carried out during the experiments on *Labeo rohita* to different concentrations of Cypermethrin which is used in agriculture to control the pests, indicated that the pesticide was highly toxic and imposed catastrophic effects on fish at sublethal lethal and acute lethal concentrations.

Altered cytological responses could be used as a tool in bio assessment to monitor ecotoxicity risks of Cypermethrin to the test species in particular and freshwater fish species in general. Definitely the study would provide valuable scientific data for formulating biomonitoring programmes in the region or elsewhere. Besides the damages caused to the fish due to the Cypermethrin could pose a health problem to human beings because of bio magnifications.

References

1. Sahu S.K., Sarangi D. and Pradhan K.C. (2006). Water Pollution in Orissa. *Orissa Review. Int. J. Env. Sc.*, 1(4), 514-522.
2. Gilden R.C., Huffling K. and Sattler B. (2010). Pesticides and health risks. *J. Obst. Gynec. Neonat. Nurs*, 39(1), 103-110.
3. Agnihorti N.P., Jain H.K. and Gajbhiye V.T. (1986). Persistence of some synthetic pyrethroid insecticides in soil, water and sediment-part I. *J. Entomol. Res.*, 10(2), 147-151.
4. Crossland N.O. (1982). Aquatic toxicology of Cypermethrin. II. Fate and biological effects in pond experiments. *Aquatic Toxicology*, 2(4), 205-222.
5. Denton T.E. (1973). Fish chromosome methodology. Banners tome House USA, 5, 129-148.
6. Ojima Y., Takayama S. and Yamamoto K. (1972). Chromosome preparation from cultured scale epithelium of teleost fish. *The Japanese Journal of Genetics*, 47(6), 445-446.
7. Sharaf S., Khan A., Khan M.Z., Aslam F., Saleemi M.K. and Mahmood F. (2010). Clinico-hematological and micronuclear changes induced by cypermethrin in broiler chicks: Their attenuation with vitamin E and selenium. *Experimental and Toxicologic Pathology*, 62(4), 333-341.
8. Ahmad L., Khan A., Khan M.Z., Hussain I., Mahmood F., Sleemi M.K. and Abdullah I. (2012). Toxicopathological effects of cypermethrin upon male reproductive system in rabbits. *Pesticide biochemistry and physiology*, 103(3), 194-201.
9. Bhushan B., Saxena N. and Saxena P.N. (2010). Beta-cyfluthrin induced histochemical alterations in the liver of the albino rat. *Scandinavian Journal of Laboratory Animal Sciences*, 37(2), 61-66.
10. Aslam F., Khan A., Khan M.Z., Sharaf S., Gul S.T. and Saleemi M.K. (2010). Toxicopathological changes induced by cypermethrin in broiler chicks: Their attenuation with Vitamin E and selenium. *Experimental and Toxicologic pathology*, 62(4), 441-450.
11. Luty S., Latuszynska J., Halliop J., Tochman A., Obuchowska D., Przylepa E. and Korczak E. (1998). Toxicity of dermally applied alpha-cypermethrin in rats. *Annals of Agricultural and Environmental Medicine*, 5, 109-116.
12. Khuda Bukhsh A.R. (1994). Localization of C-band heterochromatin in metaphase chromosomes of two species in Indian major carp. *Inland Fish. Soc. India*, 26, 44-46.
13. Majumdar K.C. and McAndrew B.J. (1986). Relative DNA content of somatic nuclei and chromosomal studies in three genera, Tilapia, Sarotherodon, and Oreochromis of the tribe Tilapiini (Pisces, Cichlidae). *Genetica*, 68(3), 175-188.
14. Zhang S.M. and Reddy P.V.G.K. (1991). On the comparative karyomorphology of three Indian major carps, Catla catla (Hamilton), Labeo rohita (Hamilton) and Cirrhinus mrigala (Hamilton). *Aquaculture*, 97(1), 7-12.
15. Krishnaja A.P. and Rege M.S. (1982). Induction of chromosomal aberrations in fish *Boleophthalmus dussumieri* after exposure in vivo to mitomycin C and heavy metals mercury, selenium and chromium. *Mutation Research/Genetic Toxicology*, 102(1), 71-82.
16. Gadhia P.K., Dholakia A.H. and Gadhia M. (1990). Cadmium nitrate induced chromosomal aberrations in a common carp *Cyrprinus carpio*. *Aquacultura Hungarica*, 6, 19-23.
17. Rishi K.K. and Grewal S. (1995). Chromosome aberration test for the insecticide, dichlorvos, on fish chromosomes. *Mutation Research/Genetic Toxicology*, 344(1-2), 1-4.
18. Pinter A., Torok G., Sutjan A., Csik M., Bonsonyi M. and Kelescsenyi Z. (1989). Genotoxicity of selected herbicides. *Ann. Ist Super Sanita.*, 25, 577-582.
19. Cajaraville M.P., Hauser L., Carvalho G., Hylland K., Olabarrieta I., Lawrence A.J. and Goksøyr A. (2003). Genetic damage and the molecular/cellular response to pollution. *Effects of pollution on fish: molecular effects and Population responses*, 14-82.
20. Al-Sabiti K. (1994). Micronuclei induced by selenium, mercury, methyl mercury and their mixtures in binucleated blocked hepatic cell techniques fish erythrocytes cells. *Mutat. Res.*, 320, 157-163.
21. Das P. and John G. (1999). Induction of sister chromatid exchanges and chromosome aberrations in vivo in *Etrophlus suratensis* (Bloch) following exposure to organophosphorus pesticides. *Toxicology letters*, 104(1-2), 111-116.