ORIGINAL RESEARCH PAPER

Zoology

TOXICITY AND FATE OF ARSENIC IN THE REPRODUCTIVE SYSTEM OF FRESH WATER TELEOST *(HETEROPNEUSTES FOSSILIS)*

KEY WORDS: Toxicity – Arsenic – *H. fossilis* – Exposure of Testis

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ABSTRACT

The impact of arsenic on aquatic flora and fauna is increasing day by day, as in the case of fish their population is getting reduced gradually. Fish population and their production have been much affected in term of both quantity and quality. In aquatic habitats fish are the most sensitive organism and get affected even upon a mild change in the surroundings. There are reports about the accumulation of arsenic in skin, gills, scale, muscles and gonads of fish. Fish and marine product have been identified as a major source of dietary arsenate in some countries. The problems are why it is necessary to protect the human population exposed through the fish contaminated with arsenic. This can only be done by protecting the fish from toxic level of arsenic which is to be evaluated so that fish population can be saved and improved in term of both quality and quantity to some extent by utilizing the data obtained by different studies.

INTRODUCTION

Arsenic are present everywhere in earth's crust and distributed throughout the environment (sancha and castro, 2000). The menaces of high arsenic concentrations in surface has been recorded by various workers India is one of the largest fish producing countries and ranks ninth among all nations. Affecting over 200000 people, which is by far the largest population under threat of arsenic induced health hazards (Lemmo et al, 1983). Urinary arsenic concentration adjustment factors and malnutrition (Nermell B, Lindberg AL, Rehman M, et al. Res., 2008). An attempt has been made in the present communication to study the acute toxicity due to sodium arsenate exposure in testis of H. fossilis as test specimens. Fish is usually considered as an organism of choice for assessing the effect of environmental pollution on aquatic ecosystem (Gernhofer et. al, 2001 ; Gaim et. al., 2015).

MATERIAL AND METHODS

Healthy and matures fresh water fish, H. fossilis (weight 20.00+ 2.00gm and length 13.50 + 0.50cm.) of both sexes were collected from the local resources and where brought to the laboratory during the month of November and December. Healthy and diseased cat fish were isolated carefully, treated with 2% solution of $KMNO_4$ and then kept in separate large 20 lit. glass aquarium for acclimatization for 14 days, under natural photoperiod and ambient temperature and fed them a daily diet of albumen. For the determination of LC_{50} values of Sodium arsenate, the 96 hours static acute toxicity test were conducted (APHA, 1998) by exposing the fish in four groups of different arsenic concentrations 5mg, 10mg, 15mg, 20mg/lit. The physiochemical properties of tap water used were – pH-7.2+0.5, dissolved oxygen content 6.80+4.35mg/lit, hardness 100+3.50mg/lit. as $CaCo_3$, temperature 17+2.00°C and electrical conductivity 450+3.40mmho/cm. The LC_{50} values computed by the method of Trimmed Spearman – karber (Hamilton et. al., 1977).

In this attempt to determine the chronic effects of Sodium arsenate on various histopathological changes of testis. The tissues were dehydrated in ascending grades of alcohols cleared in xylene and block embedded in paraffin wax (melting point 60 – 62°C). Sections were cut of 5µ on a rotary microtome and stained with haematoxylin and eosin for routine histopathological study (Mc Manus and Mowry, 1965).

RESULT

In the present investigation attention was paid towards the determination of acute toxicity of Sodium arsenate to fresh water fish and probable cause of their death. The LC_{50} and confidence limits in H. fossilis to various concentrations of Sodium arsenate for 24, 48, 72 and 96 hours have been recorded (Table – 1). Visible signs of Sodium arsenate in fish were erratic swimming, jumping, secretion of excess mucous from the gills and loss of body weight.

Table – 1 – LC_{50} values (ppm) are given with upper and lower confidence limit for 24, 48, 72 and 96 hours for H. fossilis exposed to Sodium arsenate.

Hours	Lc_{50} values	Confidence Limit	
		Upper	Lower
24	9.00	9.20	8.80
48	8.75	9.00	8.60
72	8.75	9.10	8.52
96	7.50	7.32	6.85

Histopathology –

Control – After exposure for 2 days, the testis in control fish had active stages of spermatogenesis including spermiogensis dominance of spermatids and sperm bundles with a few spermatogonials and spermatocytes with in the tubuler lumen was evident. The general histology described by many workers (Sunderraj, 1959). Sunderraj (1961) was observed several spermatogonia and spermatids in the testicular follicles.

Treated – There was marked presence of sperm bundle with in the testicular lumen, which indicated that the spermiogenesis was not much affected. However the early spermatogenic stages particularly spermatogonia and spermatocytes exhibited nuclear pyknosis and necrosis leading to complete degeneration after exposure.

DISCUSSION

The LC_{50} values of Arsenic kept on reducing with the progression of exposure time i.e. they were maximum for 24 hours and minimum for 96 hours. It indicate the arsenic are constantly absorbed and relatively more retimed by the fish as compared with mammal in which concurrent exclusion is emphatically reported. A logic reason that appears to be apparent one is that the mammalian species take up the toxicant from time to time with intervals while fish inhabits an environments in which the toxicant is constantly present by way of being dissolved.

The gonads are initially to develop under the influence of the gonadotropic hormones from pituitary which themselves are under control of brain hormones, the regulation of which is orchestrated by the hypothalamic activity (Gorbmcan and Bern, 1962). Thus it is clear that a part from many other facts if any substance causes neurological disturbance for one reason or the other, it will surely effect the disturbance and so the present toxicant have a potential to do so. Arsenic is defame for metabolic suppression. Thus expectedly the exposure of fish under any phase of gonadal cycle will have none other than a damaging or at least suppersional effects and those expectations have already been confirmed by the histological observations recorded. Arsenic finally a severe spermatogenetic degeneration was very well recorded. Developmental and reproductive toxicity shown by inorganic arsenic which is related to animal studies and human concern (Mari S. Golub et. al, 2009). As induced DNA damage in gill, liver and blood tissues exmined by Ahmed et. al, (2012-13) when the fish were exposed by different concentration of As. Begum et. al, (2013) observed in *H fossilis* when the fish exposed with 7 and 20mg/l of arsenic, degeneration in muscle bundle accompanied with focal areas of necrosis as well as atrophy and vascular degeneration found. Banerjee. et. al, (2015), observed that arsenic has a generalized immune suppressive effect leading to down regulation of both T helper cell I & T helper cell 2 cytokines, besides it led to upregulation of the

HSP genes indicating arsenic induced cellular stress when exposed to *L. rohita*.

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