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STUDY OF IMPACT OF FLY ASH OF SANJAY GANDHI THERMAL POWER PLANT ON REPRODUCTIVE PHYSIOLOGY FISHES

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ABSTRACT: - :- Pollution of aquatic resources fly ash, heavy metals etc. has become a huge challenge and serious threats to the aquatic fauna. Recent years have witnessed significant attention being paid to the problem of an environmental contamination by a wide variety of chemical pollutants toxicants; aquatic fauna like fish is badly affected. Fly ash contains many elements, including heavy metals, ions and oxides, depending on the constituents of the coal being fired for power generation, where fly ash is a byproduct. These compounds affect the water quality and in turn the fish and their reproductive behaviour. Fish in water containing fly ash were compared to fish in water without fly ash under laboratory conditions. Not only gill get affected but blood, liver, kidney, intestine, gonads also affected / damaged seriously by the toxic action. In the present piece of work reproductive physiology of fresh water experimental fish Common carp and Tilapia selected for the work is native of Indian subcontinent and abundantly found in this region is the target organ for toxicant. The aims behind these studies were annual reproductive cycles, Length of breeding season, Onset of reproductive maturity, Spawning rhythms, Fecundity and Various other aspects of reproductive biology, after the exposure of fly ash for the period of 25, 40 and 55 days.

KEYWORDS:- Fly ash, Impact of Reproductive physiology and Common carp and Tilapia.

INTRODUCTION:-

Pollution in water caused by Seasonal changes in the relative number of corpora either industries or by manmade sources is the main factor responsible for the alteration of metabolic activities in fish. The fly ash contamination changes the hydro biological features of water. Reproduction is the biological process by which new individual are produced. Reproduction is fundamental feature of all known life; each individual organism exists as the result of reproduction.

Reproduction in the experimental fishes *Cyprinus carpio* and *Tilapia* is regulated by external environmental factors that trigger internal mechanisms into action. The final event of the reproductive cycle, the release of eggs and sperm resulting in spawning, can be controlled by either placing the fish in an appropriate environment or by changing the fish's internal regulating factors with injected hormones or other substances. The internal mechanisms that regulate spawning are similar for most fishes. The external environmental factors that control reproduction, however, vary considerably among species. For this reason, more is known about the internal regulatory mechanism of fish reproduction than the specific environmental requirements for spawning each species.

Environmental factors that have been shown to play a significant role in the reproductive cycle are: Photoperiod; Water temperature; Water quality (e.g., dissolved oxygen, pH, hardness, salinity, alkalinity); Flooding and water current; Tides and cycles of the moon; Weather cycles (e.g., atmospheric pressure, rainfall); Spawning substrate (e.g., aquatic plants, Sticks, gravel, spawning mats, spawning caverns); Nutrition; Disease and parasites, and Presence of other fish. These factors do not function independently of one another, but are interrelated. While proper environmental mental conditions stimulate the reproductive process, unsuitable conditions can override any attempt at induced spawning. The internal mechanism that regulates the process of reproduction in fish is the brain-hypothalamus pituitary-gonad chain this mechanism is complex, and additional scientific information is continually being added. Environmental stimuli are received and translated by the brain. Stimuli of reproductive importance are routed to a portion of the brain called the hypothalamus.

The hypothalamus produces gonadotropin releasing hormone (GnRH) and also gonadotropin release inhibiting factors. Experimental results suggest that dopamine is substance that inhibits the release of gonadotropin. Gonadotropin releasing hormone (GnRH) is thought to stimulate the pituitary, a small gland located beneath the brain, to produce and release gonadotropin hormones (GtH). Studies of induced ovulation of many fishes using injected pituitary extract indicate that an increased blood GH is a prerequisite for ovulation. Gonadotropin hormones (GtH) act on the ovaries andtestes (gonads). Steroids and prostaglandins appear to be thelocal ovarian mediators of GtH action causing release of the eggs. Elevated blood levels of GtH trigger two distinct ovarian processes: 1) final maturation of the egg, which appears to be stimulated by steroids (e.g., progesterone) that are produced by the follicle, and 2) rupture of the follicle (ovulation), which evidently is stimulated by prostaglandins. Steroids also appear to induce spermiation in the male.

REVIEW OF LITERATURE:-

The overall pattern of gonadal development in teleost was found to be identical with few modifications Number of studies has been carried out by the researchers Some remarkable works are Sathyanesan, A.6. (1981), Yamamoto, K., Oota, I., Takano, K. & Ishikawa, T.(1985) Breeder, C. M., Jr. and D. E. Rosen (1966). Flügel,H. (1987) Flügel, H. (1967) Anderson, E. (1967). Flügel, H.(1967) Anderson, E. (1987). De Vlaming, V. L. (1972).Nakamura, M Takashi, H. (1973) Satoh, N. (1974). J. PWourms, (1976). Haffen, K (1977), Shackley, S. E. & King,P.E. (1977). Merchant-Larios, H. (1978). Wallace, R. A. &Belman, K. (1978). Al-Daham, N. K. & Bhatti, M. N. (1979).Humason, G. L. (1979) Broton, B., Horoszewicz, L.,Bieniarz, K. &Epler, P. (1980). Thresher, R. E. (1980, 1984) Wootton, R. J. (1982). Selman, K. & Wallace, R. A. (1983).Nagahama, Y. (1983). Selman, K. & Wallace, R. A. (1986).Van Oordt, P. G. W. J., Peute, J., Van Der Hurk, R. &Viveen,W.JA. R. (1987). Ozer, Z., Akpinar, M. A., Akçay, M., Erdem,0., Güler, R., Yanikoglu, A., Ergenoglu, B., Dere, S. &Savasci, S. (1987). Bardakci, F. (1987). Begovac, P. C. &Wallace, R. A. (1988) Van Der Merwe, W., Van Vuren, J. HJ. &Vermaak, J. F. (1988). Okuzawa, K., Furukawa, K., Aida,K. &Hanyu, (1989). Undar, L., Akpinar, M. A. &Yanikoglu ,A (1990). Some more work in the morphology and histology of fish testes has been revised and reviewed by Duodoroff and Katz, (1953), Jones, (1964),Sastry and Shukla, (1989), Khillare, (1989), Kaur, Dhawanand Toor, (1989), Affleck, (1952), Skidmore, (1966), Spehar,(1976). Speranza et. al; (1977), Sathyanesan, (1989)Siddiquie, (2001) and Bazzoli, (2003,2006).

The post-ovulatory follicle appeared during the whole post-spawning period. As soon as pre spawning begins these structures disappeared (saxena,1980, Upadhyaya,1984, Singh,1991, Soni,1997, Reenasoni,2006andAmbulkar, 2007.)

Present work has an objective to find out some hidden fact of the impact of coal fly ash over reproductive system and reproductive physiology of fish species. The experimental fish *Common carp* and *Tilapia* selected for the work is native of Indian subcontinent and abundantly found in this region.

STUDY AREA:-

In the present study is going to centralize on Sanjay Gandhi thermal power plant is located at Birsinghpur Pali in Umaria district of Madhya Pradesh. Sanjay Gandhi thermal power plant is situated longitude 23°18′21″N and latitude 81°03′54″E on the right pool of the Johilla river. The Power plant is one of the coal based power plant of Madhya Pradesh power generating company limited (MPPGCL).This power plant was established in 1993.

Sanjay Gandhi thermal power plant has an installed capacity of 1340.00 MW. The coal for the plant has been procured by rail from south eastern coal fields. The water for the plant has been procured from nearby Mandhar Dam which is spread across 1810 hectares.

Mandhar Dam is a multipurpose River Valley Project on river Johilla situated in the Gangas basin Madhya Pradesh, at village Birsinghpur pali in Shahdol district on Katni-Shahdol road, at a distance of 91 km from Katni and 37 km from Shahdol, located at Latitude $81^0$2' N and longitude $29^0$10' 30" E. Its catchment area is 1634.39 km2, Dam height is 50km2 and live storage is 0.09 km3.

OBJECTIVES OF THE STUDY:

(1) To check the physico-chemical and biological characteristic of fly ash.
(2) To find out some hidden fact of the impact of coal fly ash over reproductive system.
(3) To check the reproductive physiology of experimental fish species.

MATRIAL AND METHODS:-

For the lab study of behavior, the fishes used were healthy Tilapia. Two aquaria with equal amount of water were taken, keeping constant the water quality, maintained same temperature and aeration. We prepared fly ash bed in one of the aquarium, and the other was kept devoid of fly ash, as control. Fishes of approximately same size and weight were selected (approximately 3-4inches), 3 fishes were kept in each aquarium and same food in equal quantity, at regular time intervals were given. After acclimatization their behavior was observed (Stephan et al 2004) (Malina2006).

Collection of experimental fishes:- For present investigations, fresh water fish *Cyprinus carpio & Tilapia* was selected because of its easier availability and higher tolerance power. Experimental fishes were collected locally from river Murna and Johila. After collection mature fishes were brought to laboratory for experiment and younger were released into water of the collection site. Male and females were separated on the basis of their length and swollen belly. Seventy adult fishes (thirty five females and thirty five males) were collected during every reproductive phase i.e. pre-spawning, spawning and post-spawning periods. To ensure this collection was made in every month for a complete year.

Acclimatization of experimental fishes:- Collected Fishes acclimatized to laboratory condition. For the purpose of acclimatization, fishes were kept in large aquarium in the laboratory. Proper aeration and feeding was provided for more than fifteen days. After required period of acclimatization, it has been noticed that fishes are capable to tolerate laboratory conditions.

Collection of fly ash:- The Amarkantak Thermal power station located at Chachai and Sanjay Gandhi thermal power plant located at Birsinghpur Pali produce large quantity of fly ash during the generation of power as a result of coal combustion.

Exposure of experimental fish into sub-lethal concentration of fly ash:- Acclimatized fishes were processed for the study of the effects of fly ash on reproductive system and reproductive physiology. For the purpose of experiment seven set of aquarium were established for every event of reproductive cycle.

RESULT AND DISCUSSION:-

Fisheries biologists to identify have long studied of the experimental fishes *Common carp* and *Tilapia* gonad morphology at the anatomical or histological levels. The aims behind these studies were annual reproductive cycles, Length of breeding season, Onset of reproductive maturity, Spawning rhythms, Fecundity and Various other aspects of reproductive biology.

A second field of investigation is the impact of various pollutants over the reproductive mechanism. Comparative surveys vertebrate taxa have not been detailed enough, however, to describe fully the differences and similarities among gonads of bony fishes and other vertebrates in view of growing industrial as, across development.

MORPHOLOGY OF GONADS

Gonads, associated ducts and reproductive glands collectively constitute the reproductive. Seasonal change in the relative number of corpora atretica and post-ovulatory follicles: For the assessment of spawning periodicity of the fish, the quantitative study of the corpora atretica and the post-ovulatory follicles is very essential. Ten ovaries from each month were selected for this study. Corpora atretica and post-ovulatory follicles were counted from the various regions of the ovaries. Thirty sections were selected for this study.

The data obtained from this study indicate that the number of corpora atretica is more during spawning period in comparison with other periods. However they are present throughout the year and show a high frequency in the late spawning period and early post-spawning period. The large number of corpora atretica can be correlated with spawning periodicity of fish.

The presence of post-ovulatory follicles has been noticed first during spawning period after extrusion of mature oocyte. The number of post-ovulatory follicles increases during post-spawning period. During post- spawning period the post-ovulatory follicles loose their identity and absorbed in the stroma of the ovary within a month after their appearance.

IMPACT OF FLY ASH POLLUTION ON REPRODUCTION OF EXPERIMENTAL FISH-

Pollution in water caused by Seasonal changes in the relative number of corpora either industries or by man-made sources is the main factor responsible for the alteration of metabolic activities in fish. The fly ash contamination changes the hydro biological features of water. These changes include; Depletion in oxygen content of water, Change in the level of carbon Dioxide, Significant change in the pH, Increase in total dissolved solid and Chemical nature of water.

As a result, physiological process, especially reproductive physiology, of the fish is affected. Observation for the impact of fly ash contamination on reproductive activities of present experimental fish was *Common carp* made for-

Initial control fishes:-

The histological features of the Initial control fishes are similar to the normal fishes in every respect for the all phases of reproductive cycle. Ovaries of the spawning phase are packed with mature oocytes, stages of corpora atresia and little number of post- ovulatory follicles. Stages of early development were few in number. The initial control ovary at post-spawning phase is represented by more number of post-ovulatory follicles and atretic stages whereas the ovaries of initial control fishes at pre spawning phase represent the stages of early development. So far testis of initial control fishes during spawning, post spawning and pre-spawning phases is concerned; basic features of histology are present in the testis.

25 Days control fishes: -

Histological features both in ovaries and testis are similar as observed in initial control fishes i.e.:-

• Ovaries of the spawning phase of 25 days control fishes are packed with mature oocytes, stages of corpora atresia and little number of post- ovulatory follicles.
• The ovaries of the spawning phase of 25 days control fishes at post-spawning phase is represented by more number of post-ovulatory follicles and atretic stages
• The ovaries of the spawning phase of 25 days control fishes at pre-spawning phase represent the stages of early development.
• Histological features of the testis of 25 days control fishes also represent the basic features of respective phases of reproductive cycle.

25 Days fly ash treated fishes:-

In 25 days, fly ash treated fish both ovaries and testis appeared almost with normal features of their histology however some deformities have been recorded in different developmental stages:-
• Stages of atresia make their appearance even in early developmental stages of ovaries. Their number increases in advance stages i.e. in spawning and post spawning stages.
• So far testis is concerned the impact of fly ash exposure for 25 days is seen as loosely packed seminiferous tubules in comparison to the normal testis.

40 Days control fishes: -

Histological features of the ovaries and testis remains similar as described for initial control and 25 days control fishes.

• 40 Days fly ash treated fishes:-

Deformities recorded in the histology of ovaries and testis of 40 days fly ash exposed fishes are:-
•Reduction in the number of advance stages of development both in ovaries and testis.
• An increase in the number of corpora atretica in the ovaries.

55 Days control fishes:-

Histological features of the ovaries and testis remains similar as described for initial control and 40 days control fishes. The ovaries are represented with primary follicles with intact ovigerous lamellae whereas testis is represented with all developmental stages.

55 Days fly ash treated fishes:-

Maximum deformities have been recorded in the histological features of the ovaries and testis treated for 55 days in sub-lethal concentration of fly ash:-

• Cytoplasmic degeneration and additional adhesion and more retraction were visible in oocyte of pre-spawning and Spawning phase;

• The number of atretic oocytes increased.

• Damages to the oocyte of spawning phase started.

• Severe damage of the ovigerous lamellae, increased with formation of intra follicular spaces

• The ovarian wall became frayed and broken.

• Additionally, a marked increase of atretic follicles, shrinkage, and embedded nucleoli into the surrounding cytoplasm in oocyte pre spawning and spawning were observed.

• So far testis is concerned, after long term exposure of *Common carp* fish into sub-lethal concentration of fly ash results in the reduction of the number of spermatozoa and advance stages of spermatogenesis.

This study in case of present experimental fish *Common carp* revealed that long-term exposure of fish into sub-lethal concentration might alter the microscopic anatomy of the ovary.

As a result, physiological process, especially reproductive physiology, of the fish is affected. Observation for the impact of fly ash contamination on reproductive activities of present experimental fish was *Tilapia* .

CONCLUSION:-

Long term exposure of organisms to fly ash means a continuous health hazard for the population. So, human population is at high risk by consuming these toxicated fishes. This implies that one should take the necessary precaution in the application of fly ash to protect the life of fish and other aquatic fauna. It is likely that approaches using molecular biology techniques will revolutionize toxicological applications that are cheaper and do not require the use of animals to detect environmental stressors. This study in case of present experimental fish *Tilapia* revealed that long-term exposure of fish into sub-lethal concentration might alter the microscopic anatomy of the ovary.

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