



**IMPACTS OF HERBICIDE PENDIMETHALIN ON SEX STEROID
LEVEL, PLASMA VITELLOGENIN CONCENTRATION AND
AROMATASE ACTIVITY IN TELEOST CLARIAS
BATRACHUS (LINNAEUS)**

Dr. Chandan Kumar

Ph.D. (Science). VKSU. Ara. Bihar.

ABSTRACT:

Pendimethalin (PM) is a selective herbicide, widely present in aquatic environment. It causes detrimental effects in fishes, but little is known regarding its reproductive toxicity. The present study was carried out in Clarias batrachus exposed to sub lethal concentrations of PM for 30, 45 and 60 days. Male fish showed a significant increase in plasma 17 β -estradiol (E2) however plasma E2 in females was not affected. Plasma testosterone levels were significantly decreased in both sexes. In male plasma vitellogenin (VTG) and gonadal aromatase activity was increased irrespective of herbicide concentration and exposure duration. In females concentration and time dependent reduction in plasma VTG but no significant change in the gonadal aromatase activity were observed. Results indicated that PM act as endocrine disruptor but act differentially in male and female fishes and plasma E2, T and VTG levels and aromatase activity can be considered as reliable biomarkers for PM toxicity in fishes.

INTRODUCTION:

Herbicides are used worldwide with a consumption of about 47.5 % of total pesticides (De et al., 2014). Herbicides used in agricultural fields find its way to nearby aquatic systems along with the surface runoff and put their detrimental effects on non target aquatic organisms including fishes (Gilliom, 2007). These xenobiotics may have endocrine disrupting potential that can affect the reproductive capabilities of fish (Shioda and WakabaYashi, 2000). Herbicides can mimic steroid hormones and through an interaction with the estrogen receptors

may initiate transcription of the estrogen receptor regulated genes (Bolger et al., 1998).

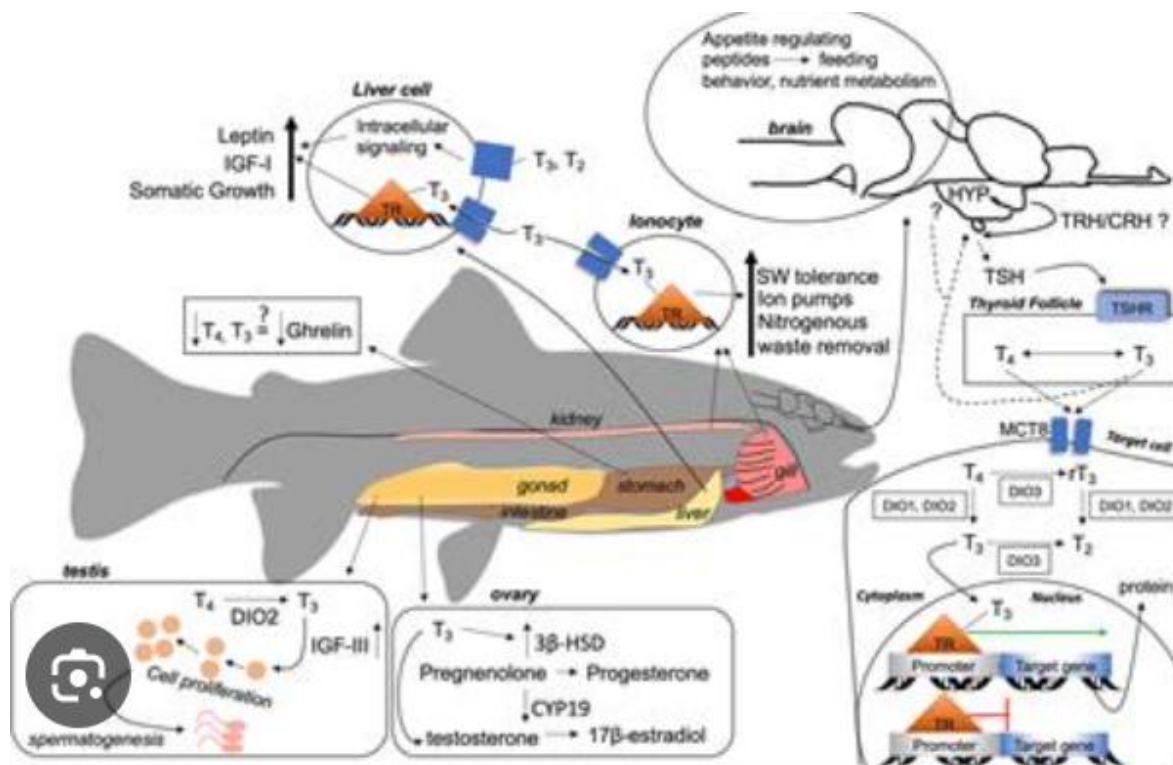
Pendimethalin is extensively used in rice fields to remove annual grasses and has been identified as a moderately persistent and bio-accumulative toxic compound (Roca et al., 2009) belonging to class dinitroaniline. Pendimethalin causes deleterious effects in fishes and is considered as moderately to highly toxic compound for fishes. Toxicity of pendimethalin varies from species to species and its impact on various aspects of fishes has been reported from time to time including induction of oxidative stress in *Channa punctatus* (Ahmad and Ahmad, 2016) and rainbow trout (Danion et al., 2014), alterations in biochemical parameters in *Oreochromis niloticus* (Nabela et al., 2011), histological changes in the gill epithelium and altered general branchial functions in *Tilapia nilotica* (Abd-algadir et al., 2011). However no work has been done so far to evaluate the reproductive toxicity of herbicide pendimethalin on fresh water catfish *Clarias batrachus*.

DISCUSSION:

Reproductive toxicity of herbicides can be evaluated through various biomarkers including determination of sex steroid level, plasma vitellogenin concentration and aromatase activity. Environment pollutants including herbicides can alter the sex steroid level by acting on hypothalamic pituitary gonadal axis (Li et al., 2009). Hormonal imbalance in a dose related manner was observed in gold fish after exposure to atrazine (Spano et al., 2004). Herbicides can also disrupt sex steroids metabolism (Moore and Waring, 1998).

Aromatase is an enzyme which converts testosterone to estradiol and thus indirectly regulates the role of testosterone in control of reproductive physiology, maintenance of masculinization in males and feedback mechanism of gonadotropic steroid secretion (Dessl-Fulgheri, 1982). The up regulation of this enzyme could result in increased production of estradiol and corresponding decrease in testosterone which ultimately leads to reduction in reproductive success of fishes.

Role of gland on teleost *Clarias batrachus* (Linnaeus) as shown in below Figure.



Ovarian estradiol regulates the synthesis of vitellogenin (VTG) in liver. VTG is a yolk precursor protein and normally its level in plasma of male fishes is very low. Herbicides may act as xenoestrogens and may stimulate synthesis of vitellogenin in males (Flammarion et al., 2000). Thus occurrence of VTG in blood plasma of male fishes is an important biomarker used to detect fish exposure to estrogenic endocrine disruptors (Sumpter and Jobling, 1995).

Till date no information is available on the effect of pendimethalin on sex steroid level, aromatase activity and VTG production in fish.

Many different fish species have been used based on their ease of culture, ecological relevance and economic importance for lethality assays. The fish species *Clarias batrachus* was selected for the present study because of several reasons. Among which wide distribution in the freshwater environment, non-invasive, availability throughout the season and easy acclimation to laboratory conditions are most important factors. *C. batrachus* is a bottom dweller fish which makes it to be in contact with xenobiotics in water as well as in sediment.

So it is obvious that such species are more susceptible to harmful impacts of pesticides than others.

CONCLUSION:

Most of the test guidelines recommend use of measured concentrations of the test chemical for toxicity studies (Organization for economic cooperation and development (OECD, 1992; USEPA, 1996; ASTM, 2007) but as per ecotox database, 66 % of such studies are based on nominal concentrations (ECOTOX; <http://www.epa.gov/ecotox/>). Studies with nominal concentration are also important because eco-toxicological models generally have large data requirements so must be based on use of both measured and nominal concentrations of testing chemical (Raimondo et al., 2009) Therefore the objectives of the present study were to evaluate the effect of nominal concentration of pendimethalin on plasma sex steroid levels, gonadal aromatase activity and VTG production in *C. batrachus*.

Fishes quickly respond to low concentration of toxicants present in aquatic environment (Cavas and Ergene-Gozukara, 2005) so they are frequently used as biomarkers to detect problems of aquatic pollution (Van der Oost et al., 2003). After entering in to an aquatic system, herbicides can adversely affect the various physiological aspects of fishes including reproduction. Therefore the present study was carried out to determine the impacts of herbicide pendimethalin on sex steroid level,

REFERENCES:

1. Meger, S. A. (1986). Polluted precipitation and the geochronology of mercury deposition in lake sediment of northern Minnesota. *Water, Air, and Soil Pollution* 30, 411–419.
2. Mukherjee, J. W. & Bhattacharya, S. (1982). Ovarian cholesterol dynamics in teleost *Channa punctatus* (Bloch): Relationship with reproductive cycle and response to gonadotropins. *General and Comparative Endocrinology* 46, 141–149.

3. Olson, K. R., Squibb, K. S. & Cousins, R. J. (1978). Tissue uptake, subcellular distribution, and metabolism of $^{14}\text{CH}_3\text{HgCl}$ and $\text{CH}_3^{203}\text{HgCl}$ by rainbow trout, *Salmo gairdneri*. Journal of the Fisheries Research Board of Canada 35, 381–390.
4. Ram, R. N. & Sathyanesan, A. G. (1986). Effect of a mercurial fungicide on the gonadal developmet of the teleostean fish *Channa punctatus* (Bloch). Ecotoxicology and Environmental Safety 11, 352–360.