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### EFFECT OF DDT ON THYROID GLAND OF THE MULLET *LIZA PARSIA* (HAMILTON-BUCHANAN)

## ABSTRACT

*Liza parsia* was exposed to 0.02 ppm DDT in sea water for 15 days. This resulted in a decrease of the follicular epithelial height, degeneration of the epithelial cells and depletion of colloid materials in the lumen of the thyroid. Even few follicles devoid of colloid materials were also seen in the gland of 15 days - treated fish.

## Introduction

THYROID hormones ( $T_3$ ,  $T_4$ ) in fish are involved in development (Higgs *et al.*, 1982; Nacario, 1983; Lam, 1985; Lam and Sharma, 1985; Lam *et al.*, 1985; Kobuke *et al.*, 1987; Sullivan *et al.*, 1987; Tagawa and Hirano, 1987, 1990; Pandey, 1989), metamorphosis (Eales, 1979; Letherland, 1982; Inui and Miwa, 1985), oxidative (intermediary) metabolism (Gorbman *et al.*, 1983; Peter and Oommen, 1989 a, b) and reproduction (Pickering and Christie, 1981; Sower and Schreck, 1982; MacKenzie *et al.*, 1987; Flett and Letherland, 1989; Norberg *et al.*, 1989; Sower *et al.*, 1992; Weber *et al.*, 1992). Further, they have also been implicated to play a role in parr-smolt transformation in salmon (Hoar, 1976; Bern, 1978; Dickhoff *et al.*, 1978, 1982; Eales, 1979; Scholz, 1980; Morin *et al.*, 1989. Recently, a number of

studies have shown that pollutants affect thyroid physiology of freshwater teleosts (Deb and Bhattacharya, 1976; Bhattacharya *et al.*, 1978, Sathyanesan *et al.*, 1978; Ram and Sathyanesan, 1984, 1987; Katti and Sathyanesan, 1987, Kirubakaran and Joy, 1989). So far, there exists no report of the effect of DDT on the thyroid gland of fish. Hence, this study was undertaken to fill this void.

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## Material and methods

Live specimens of *Liza parsia* (average size 10.5 cm) were collected from Vypeen Island (near Cochin) and transported to the

laboratory. They were maintained in well-aerated sea water (salinity 30 ppt; average temperature, 30.5°C) for a week under the laboratory conditions prior to use. Thereafter, they were randomly divided into two equal groups of 30 specimens each. Control specimens were maintained in sea water whereas experimental fish were exposed to 0.02 ppm DDT for 15 days. Five fish from both the groups were sacrificed on day 1, 3, 5, 10 and 15 following onset of the experiment. Dead fish were discarded from the study. Areas around ventral aorta (including gills) were extirpated and fixed immediately in the freshly prepared Bouin's solution. After 48 hours, tissues were washed in running tap water for 12 hours. Then, they were routinely processed in the graded series of alcohol, cleared in xylene and embedded in paraffin wax. Serial sections were cut at 6-8 $\mu$  and stained in hematoxylin-eosin and PAS.

### Results

Thyroid gland of *Liza persia* comprises follicles which are scattered loosely in the connective tissue stroma around the ventral aorta and its afferent branchial arteries. It is a highly vascularized structure (Fig. 1).

The thyroid follicles of control mullet consist of epithelial cells which surround eosinophilic and PAS-positive colloid material. The epithelial cells are generally squamous (low lining) and the lumina are completely filled with darkly stained eosinophilic colloid (Fig. 1).

There is no apparent change in the histology of the gland in 1, 3 and 5 days DDT-treated fish whereas on day 7 of the treatment, there are marked degenerative changes (vacuolation and necrosis) of the follicular epithelial cells. Also, the colloidal materials show slight loss in its staining response

and there is a considerable reduction in its contents in the follicular lumina too (Fig. 1). However, these degenerative changes are further exaggerated in 10 and 15 days of DDT treatment which are evident by the complete necrosis of the follicular epithelial cells, decline in the



FIG. 1. Thyroid follicles (F) of *Liza persia* maintained in sea water (control). Mark the darkly stained colloid materials (CO) in the lumina of the follicles. Hematoxylin-eosin. X 400.



FIG. 2. Thyroid follicles of *Liza persia* on day 7 of DDT treatment showing vacuolation (arrow) and depletion of colloid material (CO). Also, mark the degenerative changes in the follicular epithelial cells. Hematoxylin-eosin. X 400.

staining response of the colloid material and a marked decrease in the colloidal content of the follicles. Even few follicles devoid of colloid materials are also encountered in the gland of 15 days-treated fish (Fig. 3).

### Discussion

Studies related to the effects of pollution on the thyroid physiology of fish are few and the observations are conflicting. Joy and Sathyanesan (1977 - in *Clarias batrachus*), Ram and Sathyanesan (1983, 1987-in *Channa punctatus*), Katti and Sathyanesan (1987 - in



FIG. 3. Thyroid follicles of *Liza parsia* on day 15 of DDT exposure depicting a slight loss in the staining response of the colloid, vacuolation (arrow) and depletion of colloid material in the lumina of follicles. Further, few follicles devoid of colloid materials (broken arrow) are also seen. Hematoxylin-eosin. X 400.

*Clarias batrachus*) and Pandey *et al.* (1992 - in *Liza parsia*) recorded hypertrophy, increased follicular epithelial height and vacuolation as well as reduction in the amount of colloid materials in response to ammonium sulphate, mercuric chloride and lead nitrate treatments. Recently, Krubakaran and Joy (1989) also

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noticed similar changes in the thyroid gland of a catfish exposed to the three mercurial (mercuric chloride, methyl mercuric chloride and emisan 6) compounds. However, it is interesting to note that the gland of the experimental fish showed a considerable decline in the radioiodine ( $I^{131}$ ) uptake (Katti and Sathyanesan, 1987; Kirubakaran and Joy, 1989). Further, serum protein-bound iodine (PBI) levels decreased significantly in *Clarias batrachus* treated with mercurial compounds for 3-6 months (Kirubakaran and Joy, 1989). The apparent increase in the activity of thyroid has been attributed to the enhanced secretion of thyroid stimulating hormone (TSH) from the pituitary due to the impairment of the thyroid hormone secretion (Joy and Sathyanesan, 1977; Sathyanesan *et al.*, 1978; Katti and Sathyanesan, 1987; Joy and Kirubakaran, 1989). Bhattacharya *et al.* (1978) noticed *in vitro* an inhibition in the thyroid hormone production in *Anabas testudineus* due to the exposure to endrin. In the present study, we noticed a decrease in the activity of thyroid gland of *Liza parsia* in response to the organochlorine pesticide (DDT) treatment. It is not known whether DDT causes its effects directly at thyroid level or at the hypothalamo-hypophysial level by altering the secretion of TSH. However, it is pertinent to remark that hypofunction of the thyroid in phenol, sodium sulphide and carbon disulphide - treated *Ophiocephalus punctatus* has been ascribed to the inhibition of peroxidase activity in the gland (Deb and Bhattacharya, 1976).

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