Prostaglandinal Effect on Thyroid Gland Related to Reproduction in The Fish, *Cyprinus Carpio* (L.)

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Abstract— Prostaglandins are a class of fatty which is a potent sex attractant.It plays an important role in ovulation, luteal function, implantation and maintenance of gestation. Thyroid gland has a definite role in the reproductive physiology. Prostaglandin was injected 1.5ml/kg body weight once in a week for six weeks intramuscularly in the fish, Cyprinuscarpio. It has been observed that due to prostaglandin, the follicular epithelial cell height of thyroid is increased remarkably as thyroid follicles are filled with colloid and some showed resorption vacuoles along the epithelial lining and thyroid follicles activity is enhanced. Thus, it had been concluded that prostaglandin is an inducer of spawning reflexes in the fish, Cyprinuscarpio that induces gonadal maturity as well as enhanced thyroid follicular activity resulting in early breeding.

Index Terms— Colloid, prostaglandin, resorption vacuole, reproductive physiology, spawning reflexes.

I. INTRODUCTION

Prostaglandins widely distributing in the animal kingdom (Christ, E. J. and van Dorp, 1972; Nomura, T. and Ogata, 1976 and Ogata H. *et al*., 1978) exert profound effect on the reproductive system in mammals is now generally accepted. Prostaglandin F reaches a maximum in ovulated follicle at the time of ovulation (Yang *et al*., 1974).Prostaglandin also improves sperm quantity in the canine ejaculate would benefit all assisted reproductive techniques used in all species (Milan Hess, 2002).In fish, exogenous prostaglandins also show stimulatory effect on the induction of ovulation. Ovulation of trout follicles matured in vivo could be induced in vitro by adding prostaglandin $F_2\alpha$ (Jalabert and Szollosi, D., 1975). The positive effect of prostaglandin on induction of ovulation in a fresh water cat fish was demonstrated in vivo (Singh, A. K. and Singh, T. P., 1976).Recently, existence and role of prostaglandin in fishes have been studied by several authors in many fishes. F prostaglandins also function as a hormone that stimulates female sexual behavior (Sorensen *et al*., 1988; Davidson *et al*., 2008). It is now cleared that this hormonal compound are also functioning as potent olfactory stimulants with pheromonal activity for many species of fish (Sorensen and Goetz, 1993).So little is understood about $PGF_2\alpha$ production and metabolism in fish that differences in pheromonal signals may exists.At the time of ovulation female goldfish produce large quantities of prostaglandin (PGF2) which acts as hormone to trigger spawning (oviposition) behaviors (Stacey and Peter, 1979) before being metabolized and released where males recognized it as a releaser pheromone (Sorensen and Goetz, 1993; Sorensen *et al*., 1995). Prostaglandin is a potent sex attractant (Sorensen *et al*., 1995a, 2000 and Maysa C. &Shahla j. 2015). PGF2α appears to induce the release of a female specific chemical in *P.promelas* that triggers courting behavior in conspecific males (Cole K. S. and Smith R.J., 1987). Recent studies indicate that F prostaglandin is metabolized and released into the water where it functions as a sex pheromone stimulating male sexual behavior.F prostaglandins are potent chemical stimulants in cypriniformes and suggest that F prostaglandin may be commonly used as sex pheromone in cypriniformes (Kitamura *et al*., 1994). The thyroid hormone has been considered important during fish migration. The thyroid gland seems to be active during migration period of fish for breeding purpose (Brown, C.L., and Stetson, M.H., 1983; Robertson, O.H. and Wexler, B.C., 1960). Many authors proposed a thyroid gland axis and physiological link has been claimed between these two gland (Mc Bride, J.R., 1967; Lewis, M., and Dodd, J.M., 1974; Chakraborti, P. and Bhattcharya, S., 1984; Fontaine, M. and Leloup, J.1964). Calcitonin, another hormone of the fish thyroid is concerned with calcium regulation.This hormone plays an important role in reproductive cycle facilitating calcium supply during egg formation in female fishes. The thyroid

gland is essential for reproductive success in female dog fish (Lewis, M., and Dodd, J.M., 1974). Effect of prostaglandin on thyroid in relation to reproduction in the fish, *Cyprinuscarpio* (L.) is meager and hence present work is an attempt in this direction to assess its potency as an inducer of spawning reflexes that induces gonadal maturity andas well as enhanced thyroid follicular activity resulting in early breeding.

II. MATERIALS AND METHODS

Maturing male and female of *Cyprinuscarpio* were collected, reared separately in a fibre glass tanks and acclimatized to the laboratory conditions. The experiment was carried out for six weeks. Control and experimental groups were formed by keeping male and female separetaly up to fifth dose. Male and female of control groups were injected with 1.5ml of distilled water and experimental groups were injected with 1.5ml of prostaglandin intramuscularly. After fifth week of treatment, male and female were kept together in the ratio 2:1 for sixth dose to observe the breeding. At the end of fifth week of treatment, male and female of control and treated groups were sacrified to study the histomorphological changes in thyroid and gonads.

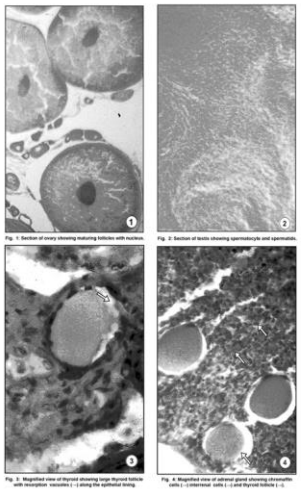
III. OBSERVATIONS/RESULTS

Thyroid gland of control group is heterotropic structure and consisted of follicles distributed around blood vessels in pharyngeal region and head kidney. They were small and mostly oval in outline. They were surrounded by epithelial cell lining and its cell height measured about 2.07µ. Each follicle was about 48µ in diameter and was filled with colloid (Table 1,). The ovary was in the maturing form and histologically, reorganized into young oocytes, early maturing oocytes (measured about 117µ) (Table 1), advanced maturing oocytes and few mature oocytes (prespawning oocyte). The ovaries were yellowish in colour. Histologically oocyte showed small clear yolk vesicles and nucleus with undulated nuclear membrane.Testis were opaque and in the maturing phase. In a section, a large number of primary, secondary spermatocytes and spermatids were visible.After injectingdistilled water to the control group, no sign of courtship was observed.

In the experimental group, the follicular epithelial cell height (6.53 ± 0.98µ) (Table 1) was remarkably increased and thyroid follicles were filled with colloid and some showedresorption vacuoles along the epithelial lining (Fig. 3). Follicular diameter measured about 36µ (Table 11). Thyroid follicles were also seen in kidney tissue (Fig. 4). At the end of 5th dose, the ovaries were in prespawningphase. The entire body cavity was occupied by the ovaries which were turgid and deep yellow in colour. The number of ova could be seen by the nacked eye through the thin ovarian wall. The ova were opaque as well as translucent. The fish was gravid with rounded abdomen. On pressing, eggs oozed out. At the end of 5th week, histologically, a large number of oocytes (448 µ in diameter) with fused yolk vesicles, yolk globules and migrating nucleus (Fig. 1) along with ripe eggs were seen in a section and became ready to spawn. A fully ripe gravid female has soft bulging rounded abdomen with swollen reddish vent.At the end of the 5th dose, there was considerable increase in the weight and volume of the testis, which becames turgid. Histologically, the seminiferous tubules were increased in size, full of sperms (Fig. 2) and with some releasing sperms (Fig. 2). The spermatogonia were reduced in number while all other stages of spermatogenesis were seen in the tubules. Milt oozed out on pressing the abdomen of the fish. In the male, the abdomen was almost flat, the vent was not swollen. Pectoral fins were slightly longer than that of female. After the 5th week, male and female were kept together (2 : 1) in a breeding tank with circulating water. After 3 hrs of 2nd injection, the brooders started swimming actively, became excited and restless. Female was chased by the males pushing her with snout and after4hrs of 2nd injection, spawning occurred.

Table 1:- cell diameter of thyroid and ovary
All measurements are in µ
± Standard error

Treatment	Thyroid		Adrenal	Ovary
	Follicular Diameter	Epithelial Cell Height	(Nuclear Diameter of interrenal cells)	(Oocyte Diameter)
Control	48	2.07 ± 0.57	2.07 ± 0.52	117
Prostaglandin	36	6.53 ± 0.98	4.54 ± 0.78	448



IV. DISCUSSION

The exact biochemical mechanism of ovulation in fish has not been fully elucidated. Very little information is available on ovarian maturation in fishes (Hirose, 1976 and Jalabert, 1976). But in rainbow trout, northern pike and gold fish 17α hydroxy-20β-dihydroprogesterone plays a preferential role in initiating maturation and ovulation may be triggered in vitro by prostaglandin $F_2\alpha$ action on mature follicles (Jalabert, 1976).The present results reveal that prostaglandin $F_2\alpha$ plays an important role in maturation and ovulation of fish *Cyprinuscarpio.* Male and female both exhibit an increased frequency of courtship behavior following prostaglandin $F_2\alpha$ treatment which is also supported by the views of (Cole K. S and Smith R. J. 1987). Present study investigated the possibility of prostaglandin $F_2\alpha$ may have pheromonal role in *Cyprinuscarpio* as it stimulates both male and female to breed easily by exhibiting vigorous courtship. The pheromonal role of $PGF_2\alpha$ in Atlantic Salmon by measuring the olfactory sensitivity acting as a potent odourant in mature salmon (Moore and Waring (1996). $PGF_2\alpha$ play a paracrine role in the ovary of teleost fish stimulating and modulating follicular rupture, circulating levels of $PGF_2\alpha$ rise at the time of ovulation and travel to the brain where they elicit female sexual behavior (Sorensen and Goetz 1993). In the presence study, $PGF_2\alpha$ also stimulates oocyte maturation in *Cyprinuscarpio.* At the time of ovulation female gold fish oviducts synchronise and secrete $PGF_2\alpha$ that induces reproductive behaviour (Stacey and Peter, 1979; Sorensen *et al*., 1988, 89, Sorensen and Goetz, 1993). Present studies also indicate that F prostaglandin is metabolised and released to the water where it functions as a sex pheromone. Therefore, $PGF_2\alpha$ also plays a dual role as a para hormone and hormone, synchronising male and female sexual behavior in *Cyprinuscarpio*. Exposure to water borne $PGF_2\alpha$ increased neurogenesis and GnRH concentration in male goldfish brain and modulate brain plasticity associated with behavioral changes during spawning season via the neuroendocrine (GnRH) and motor components of the pheromone-reproductive system (Davidson *et al*., 2008). This fiinding confirms the above view in *Cyprinuscarpio* in relation with increased number of gonadotrops increased secretary activity in thyroid. In the fish, *Cyprinuscarpio* sexual preparation like intensive courtship with maximum number of sperms in the testis has been observed by the $PGF_2\alpha$ treatment as well as the number of the interstitial cells has also been increased in the testis and the thyroid appears to be active in the fish *Cyprinuscarpio*establishing the thyroid – gonad axis and physiological link between these two glands supporting the earlier views of (Mc Bride, J.R., 1967; Lewes, M., and Dodd, J.M., 1974; Chakraborti, P. and Bhattcharya, S., 1984; Fontaine, M. and Leloup, J. (1964).

CONCLUSION

Thus, it had been concluded that prostaglandin is an inducer of spawning reflexes in the fish, *Cyprinuscarpio* that induces gonadal maturity as well as enhanced thyroid follicular activity resulting in early breeding. The thyroid gland appeared to be involved in reproduction forming possible axis between thyroid and gonads indirectly.

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