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# Neuroendocrine Regulation over Gonad Development and Growth of Secondary Sexual Organs in Freshwater Crab, *Barytelphusa cunicularis* (Westwood-1836, Decapoda, Potamonidae)

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Abstract

Neuroendocrine control over development of gonads and secondary sexual organs was studied in *Barytelphusa cunicularis*, collected from backwaters of Jayakwadi Dam. Male and female were divided equally into different groups and length of pleopod and abdomen in female and chela in male, measured before start and at the end of experiment. Eyestalk of both male and females were removed and both were administrated with extract of eyestalk, brain and thoracic extract hormones. When eyestalks were removed both in male and female the ovarian weight and testicular weight increased that increase was due to increase in number of oocytes and seminiferous tubules. Eyestalk removal also stimulated growth of abdomen, pleopod and chela in both sexes. Administration of eyestalk hormone resulted into inhibition of spermatogenesis and oogenesis. Male and females administrated with brain, thoracic ganglion hormone showed promotion over gonadal development and growth of secondary sexual organs, pleopod, abdomen and chela was also reported. Effect on secondary sexual organs was much by brain hormones when compared with others, suggesting presence of some factors. In *Barytelphusa cunicularis,* eyestalk has inhibitory principle of gametogenesis, whereas brain and thoracic ganglion hormones have stimulatory principles.

Key Words: *Barytelphusa cunicularis*, neuroendocrine hormone, gonad maturation, secondary sexual organ

## Introduction

In crustaceans many functions have been attributed to the crustacean eyestalk hormones. Eyestalk ablation in crustacean brings about changes in their physiological functions such as growth [16] and reproduction [9]. Eyestalk ablation brings about rapid maturation of the ovary in some cases and in others previous vitellogenesis does not take place. The effect of eyestalk ablation in prawn, *Palemon paucidens* at various stages of ovary was investigated [14].

The presence of testis inhibiting factors in the eyestalk of male was shown in crabs. In these animal's eyestalk ablation resulted in the increase of the weight of testis and the diameter of vas deference. However, in large number of crustaceans, the effect of eyestalk ablation is manifested by moulting alone and not by gonadal development [1] In *Scyll serrata,* [22] stated that eyestalk ablation in the young crab resulted in an increase in the weight of testis accompanied by an increase in the diameter of seminiferous tubules, vas deference and number of cells per seminiferous tubules. [25] investigated the effect of eyestalk ablation on the spermatogenesis in *Uca pugnax*. It has been confirmed by diversified experiments, such as organ ablation and transplantation, hormone purification and gene clone, that x organ–sinus gland complex is synthesis center of GIH, and secretion of $C_3$ cells in x-organ reduces as ovary develops, and reaches the minimum when ovary enter the development stage and near-mature stage [7]. The effect of brain and thoracic ganglion in the oogenesis has been worked out by [9] in *Libinia emerginita.*The hormonal control of spermatogenesis was studied in *Lysmata seticaulata* [23] Ovarian development of female crustacean is under the direct regulation of two neurohormones gonad- stimulating hormone (GSH) secreted by brain and thoracic ganglion and gonad inhibiting hormones (GIH) secreted optic ganglion [7] In-vitro studies on, *Uca pugilater, Procumbarus clarkia* and *Scylla serata* have clarified that GIH and GSH have direct influence on the ovary i.e. ovary is target organ of GIH and GSH [6, 15, 12] Eyestalk removal also result in proportionality larger increase in size with each ecdysis in adults in larva [3, 18, 2, 20] stated that animal which underwent bilateral eyestalk ablation earlier in larval life grew to larger overall size to unablated controls. Recently Ye and Haung [24] in *Scylla serrta* confirmed that brain and thoracic ganglion regulate testicular development through AG in male crustacean.

Far less known about hormonal control of gonad maturation in fresh water crab, *Barytelphusa cunicularis* and even nobody has correlated effect of neuroendocrine hormones on reproduction and growth of secondary sexual

organs, hence present work reports effect of eyestalk ablation and administration of brain and thoracic ganglion hormones on development of gonads and of secondary sexual organs in crab, *Barytelphusa cunicularis.*

## Material and Method

The freshwater crabs, *Barytelphusa cunicularis* with the help of fisherman, were collected from backwater of Jayakwadi dam. The experiment was started on 16 Feb 2009. Animals when collected from region average air temperature in the region was between $30^0$C ± $33^0$C. Male and female were handled separately and carapace length (CL), chela length (major and minor), pleopod length (AP) and abdominal length of animals were measured. All the measurements were taken to the nearest 0.1 mm by using vernier caliper. Prior to treatment crabs were acclimatized to the laboratory conditions and kept in aerated glass aquarium. Brain, thoracic ganglion, eyestalks and gonads of male and females were excised and homogenized in distilled water (2 Es, B, and Tg/Male and female). The homogenates were centrifuged at about 5000 r.p.m. for 10 minutes. The aqueous layer was removed and stored in refrigerator until used as a crude tissue extract. Males and females were injected (U-40 Insulin BD syringe) with 0.2 ml extracts of hormones on 2nd, 5th, and 10th day of the experiment.

Males and females were divided equally into following groups 1) Untreated base control (10 crabs) sacrificed and fixed on the '0'of the experiment. 2) Bilateral eyestalk ablated animals (16 crabs) 3) Experimental control (16 crabs) 4) Bilateral eyestalk ablated animals receiving eyestalk extract injection (16 crabs) 5) Bilateral eyestalk ablated animals receiving brain extract injection (16 crabs) 6) Bilateral eyestalk ablated animals receiving thoracic ganglion extract injection (16 crabs) 7) Normal individuals animals receiving eyestalk extract injection (16 crabs) 8) Normal individuals animals receiving brain extract injection (16 crabs) 9) Normal individuals animals receiving thoracic ganglion extract injection (16 crabs).

During experiments crabs were fed with earthworms and prawn debris, thrice a week. Average room and water temperature was recorded, 28-$30^0$C.

On the last day of experiment (21st), the ovary and testis were fixed in Bouin's solution, for observing changes in gametogenesis. After 24 hours of fixation, tissues were cut into three or four parts of each gonad and dehydrated in alcohol series and were paraffin embedded (58-$60^0$). Histological sections were cut at 7-8µ and stained with Harrie's haematoxylin and eosin. The criteria used to determine gonad maturity were: existence of testicular lobulation and presence of spermatids and spermatozoa in testis for male crabs, and presence of oocytes undergoing secondary vitellogenesis for female crabs. The numbers of oocytes were counted for each section and percentage was calculated for each month. Also diameter of oocytes and seminiferous tubules were noted. Gonads of males and females were individually weighed in an electronic monopan balance (± 0.001g).

Carapace length (CL), chela length (major and minor), pleopod length (AP) and abdominal length were also noted on the last day of experiment to see effect on development of secondary sexual organs, in experimental and control animals.

## Result

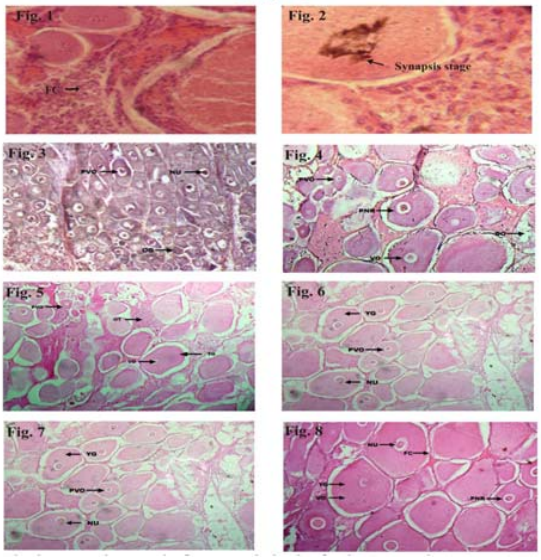
The freshwater crab, *Barytelphusa cunicularis* is continuous breeder, but major peak was June to August and minor peak was January to May.

### *Effect on Females*

### *Eyestalk ablation*

When eyestalks were removed the ovarian weight increased that increase was due to increase in number of oocytes and also increase in oocyte diameter (Plate-I-Fig. 2 and Table 1). Eyestalk removal in female resulted in increase the carapace length, major and minor chela length. Area of pleopod and abdomen length was also increased (Table 2 & 3).

**Plate - I**




The hormonal control of oogenesis in the freshwater crab, *Barytelphusa cunicularis*

Fig. 1 T. S. of control group of ovary, 400x, Fig. 2 T. S. of ovary showing accelerated oogenesis in bilateral eyestalk ablated crab, 400x, Fig. 3 T. S. of ovary showing arrested oogenesis in normal crab injected with eyestalk extract, 400x, Fig. 4 T. S. of ovary showing normal oogenesis in bilateral eyestalk ablated crab injected with eyestalk extract, 400x, Fig. 5 T. S. of ovary showing precocious oogenesis in normal crab injected with brain extract, 400x, Fig. 6 T. S. of ovary showing accelerated oogenesis in bilateral eyestalk crab injected with brain extract, 400x, Fig. 7 T. S. of ovary showing precocious oogenesis in normal crab injected with thoracic ganglion extract, 400x, Fig. 8 T. S. of ovary showing accelerated oogenesis in bilateral eyestalk crab injected with thoracic ganglion extract, 400x.

FC- Follicular cells, CM- Cell membrane, NU- Nucleus, PNR- Perinuclear region, YG- Yolk globule, YV- Yolk vesicle, PVO- Previtellogenic oocytes, VO- Vitellogenic oocytes, NP- Nutritive phagocytes.

Table 1: Hormonal control of oogenesis in the crab, *Barytelphusa cunicularis*; Role of neuroendocrine hormones

| Treatment | Wet weight of ovary (mg) | Oocyte diameter (μ) | Number of oocytes |
|---|---|---|---|
| Intact control | 20.79 ± 1.01 | 111.17 ± 3.08 | 53.65 ± 2.68 |
| Eyestalk ablated | 38.31 ± 2.73 | 212.74 ± 4.24 | 105.22 ± 4.89 |
| Normal + Eyestalk injection | 25.49 ± 1.50 | 101.66 ± 1.57 | 54.30 ± 2.40 |
| Eyestalk ablated + Eyestalk injection | 27.91 ± 1.91 | 125.30 ± 4.11 | 64.23 ± 1.04 |
| Normal + Brain injection | 34.97 ± 2.11 | 140.91 ± 3.67 | 74.23 ± 3.46 |
| Eyestalk ablated + Brain injection | 48.96 ± 2.69 | 179.18 ± 2.67 | 86.51 ± 2.47 |
| Normal + Thor.gan. extract injection | 35.21 ± 2.52 | 140.39 ± 3.26 | 73.83 ± 2.83 |
| Eyestalk ablated + Thor.gan. extract inj. | 48.74 ± 2.84 | 179.48 ± 3.23 | 86.87 ± 3.01 |

*Eyestalk hormone injection*

When eyestalk hormone extract injected into normal individuals, the ovarian weight, oocyte size and also number of oocytes decreased (Plate-I-Fig. 3& Table 1) when compared with experimental control and when injected into eyestalk less individuals, there was reduction in their ovary size, oocyte size and number (Plate-I-Fig.4 & Table 1) when compared with eyestalk less animals. The minor chela length was decreased in normal female whereas no major changes were recorded in other characters in male and female (Table 2&3).

Table 2: Showing effect of eyestalk ablation and neuroendocrine hormones on the development of secondary sexual organs in normal female of freshwater crab, *Barytelphusa cunicularis*

| Treatment | Major chela length Mean ± S.D. $1^{st}$Day $21^{st}$Day | Minor chela length Mean ± S.D $1^{st}$Day $21^{st}$Day | Area of pleopod Mean ± S.D. $1^{st}$Day $21^{st}$Day | Abdomen width Mean ± S.D. $1^{st}$Day $21^{st}$Day |
|---|---|---|---|---|
| Intact control | 70.1 ± 3.17 | 56.1 ± 3.07 | 34.6 ± 1.26 | 25.4 ± 5.21 |
| | 71 ± 3.23 | 57 ± 3.05 | 35.7 ± 1.33 | 26.9 ± 5.36 |
| Bilateral eyestalk abl | 70.1 ± 3.1 | 56.1 ± 3.07 | 35.3 ± 1.88 | 26.3 ± 5.22 |
| | 74.4 ± 4.64 | 60.2 ± 2.93 | 45.1 ± 4.65 | 27.9± 5.93 |
| Eyestalk hor. Injection | 70.7 ± 3.36 | 55.8 ± 2.89 | 35.3 ± 1.7 | 26.1 ± 5.36 |
| | 70.3 ± 3.52 | 56.0 ± 3.01 | 36.5 ± 1.64 | 27.6 ± 6.96 |
| Brain hor.injection | 71 ± 3.82 | 55.8 ± 2.97 | 35.7 ± 2.1 | 26.2 ± 5.88 |
| | 75.2 ± 4.26 | 60.8 ± 3.64 | 45.3 ± 3.3 | 30.9 ± 8.76 |
| Thoracic ganglion injection | 70.7 ± 3.65 | 55.8 ± 3.29 | 35.3 ± 2.0 | 26.4 ± 6.29 |
| | 75.3 ± 4.71 | 61.9 ± 5.15 | 47.6 ± 5.64 | 29.7 ± 9.87 |

Table 3: Showing effect of eyestalk ablation and neuroendocrine hormones on the development of secondary sexual organs in eyestalk ablated female of freshwater crab, *Barytelphusa cunicularis*

| Treatment | Major chela length Mean ± S.D. $1^{st}$Day $21^{st}$Day | Minor chela length Mean ± S.D $1^{st}$Day $21^{st}$Day | Area of pleopod Mean ± S.D. $1^{st}$Day $21^{st}$Day | Abdomen width Mean ± S.D. $1^{st}$Day $21^{st}$Day |
|---|---|---|---|---|
| Intact control | 70.1 ± 3.17 | 56.1 ± 3.07 | 34.6 ± 1.26 | 25.4 ± 5.21 |
| | 71.0 ± 3.23 | 57.0 ± 3.05 | 35.7 ± 1.33 | 26.9 ± 5.36 |
| Bilateral eyestalk abl | 70 ± 3.19 | 56.2 ±3.08 | 34.8 ± 1.47 | 25.9 ± 5.2 |
| | 75.2 ± 5.86 | 60.6 ± 3.16 | 44.4 ± 4.32 | 28.4 ± 6.39 |
| Eyestalk hor. Injection | 70.5 ± 3.20 | 55.9 ± 3.03 | 35.3 ± 1.63 | 26.2 ± 5.69 |
| | 71.0 ± 4.18 | 56.0 ± 2.98 | 36.2 ± 1.47 | 34.8 ± 8.08 |
| Brain hor.injection | 71.3 ± 3.83 | 56.2 ± 3.22 | 35.2 ± 2.26 | 26.3 ± 6.92 |
| | 75.5 ± 4.35 | 61.6 ± 4.76 | 44.9 ± 4.52 | 26.3 ± 6.92 |
| Thoracic ganglion inj. | 70.4 ± 3.47 | 55.6 ± 3.16 | 34.5 ± 2.32 | 44.0 ± 4.52 |
| | 76.3 ± 6.36 | 62.2 ± 5.34 | 44.0 ± 4.52 | 28.2 ± 7.28 |

*Brain hormone injection*

Administration of brain hormone in normal individuals showed an overall increase in their ovarian growth (Plate-I-Fig. 5 and Table 1). The eyestalk less individuals after treated with brain hormone injections, showed increase in the oocytes diameter and also wet weight of ovary (Plate -I-Fig. 6 and Table 1). It resulted in growth of all body parts in normal as well as eyestalk ablated females and major growth was recorded in abdomen length and area of pleopod (Table 2 & 3).

*Thoracic ganglion hormone injection*

When thoracic ganaglionic hormone administrated to the normal individuals, the weight of ovary, oocytes diameter and also the number oocytes was increased (Plate-I-Fig. 7 & Table 1). Thoracic ganglion hormone when administrated to eyestalk less crabs, there was increase in weight of ovary, oocyte diameter and also in the number of oocytes (Plate-I-Fig. 8 & Table 1). It caused growth of major and minor chela. Growth was also recorded in pleopod and abdomen but it was less when compared with eyestalk ablated female (Table 2 & 3).

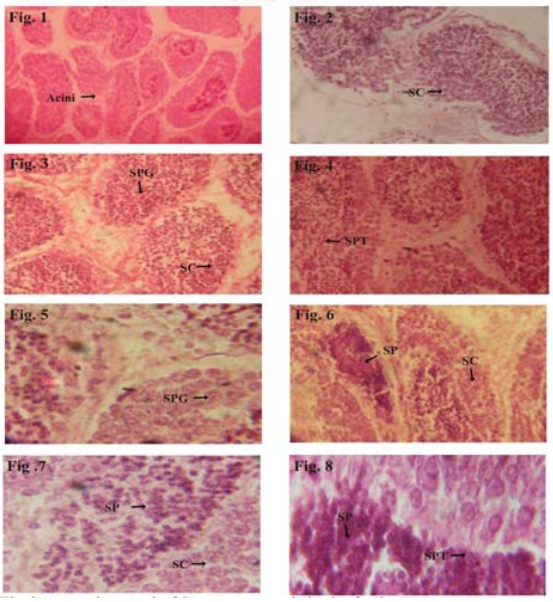
The increase in the eyestalk ablated individuals was greater than that of normal; however this increase was significantly lesser than that of eyestalk less individuals receiving brain extract injection.

*Effect on Males*

*Eyestalk ablation*

Bilateral eyestalk ablation in the male crabs increased the general weight of testis, number of acini and also their diameter (Plate-II-Fig. 2 and Table 4). Major and minor chela length increased rapidly where as no marked changes found in the length of abdomen and area of pleopod (Table 5 & 6).

Plate - II




The hormonal control of spermatogenesis in the freshwater crab, *Barytelphusa cunicularis*

Fig. 1 T. S. of control group of testis, 400x, Fig. 2 T. S. of testis showing accelerated spermatogenesis in bilateral eyestalk ablated crab, 400x, Fig. 3 T. S. of testis showing arrested spermatogenesis in normal crab injected with eyestalk extract, 400x, Fig. 4 T. S. testis of showing normal spermatogenesis in bilateral eyestalk ablated crab injected with eyestalk extract, 400x, Fig. 5 T. S. of testis showing precocious spermatogenesis in normal crab injected with brain extract, 1000x, Fig. 6 T. S. of testis showing accelerated spermatogenesis in bilateral eyestalk crab injected with brain extract, 400x, Fig. 7 T. S. of testis showing precocious spermatogenesis in normal crab injected with thoracic ganglion extract, 400x, Fig. 8 T. S. of testis showing accelerated spermatogenesis in bilateral eyestalk crab injected with thoracic ganglion extract, 400x.
SC- Spermatocyte, SPG- Spermatogonia, SPT- Spermatids, SP- Spermatozoa

Table 4: Hormonal control of spermatogenesis in the crab, *Barytelphusa cunicularis*; role of neuroendocrine hormones

| Treatment | Wet weight of testis (mg) | Seminiferous tubules dia.(μ) | Number of seminiferous tubules |
|---|---|---|---|
| Intact control | 37.52 ± 1.45 | 168.5 ± 7 1.94 | 201.69 ± 2.35 |
| Eyestalk ablated | 55.83 ± 5.22 | 242.30 ± 5.65 | 232.45 ± 6.79 |
| Normal + Eyestalk injection | 38.8 ± 2.00 | 218.74 ± 8.08 | 206.69 ± 3.89 |
| Eyestalk ablated + Eyestalk injection | 39.71 ± 2.79 | 216.88 ± 6.57 | 208.39 ± 5.70 |
| Normal + Brain injection | 48.49 ± 2.58 | 233.24 ± 5.01 | 221.78 ± 7.38 |
| Eyestalk ablated + Brain injection | 55.67 ± 5.05 | 242 ± 5.10 | 232.07 ± 6.12 |
| Normal + Thora. Gan extract injection | 48.81 ± 3.01 | 234.46 ± 6.09 | 222.74 ± 7.96 |
| Eyestalk ablated + Tho.gangextract inject | 51.07 ± 5.88 | 236.67 ± 7.36 | 225.58 ± 8.15 |

Table 5: Showing effect of eyestalk ablation and neuroendocrine hormones on the development of secondary sexual organs (mm) in normal male freshwater crab, *Barytelphusa cunicularis*

| Treatment | Major chela length Mean ± S.D. 1st Day 21st Day | Minor chela length Mean ± S.D 1st Day 21st Day | Area of pleopod Mean ± S.D. 1st Day 21st Day | Abdomen width Mean ± S.D. 1st Day 21st Day |
|---|---|---|---|---|
| Intact control | 70.3± 3.33 | 56.1 ± 3.07 | 35.6 ± 1.88 | 26.1 ±5.42 |
| | 71.6 ± 3.68 | 57.4 ± 3.30 | 36.5 ± 2.12 | 26.3 ± 5.31 |
| Bilateral eyestalk abl | 70.3 ± 3.33 | 56.1 ± 3.07 | 35.3 ± 1.88 | 26.1 ± 5.42 |
| | 74.1 ± 4.17 | 60.2 ± 2.93 | 43.7 ± 3. | 26.4 ± 5.52 |
| Eyestalk hor. Injection | 70.7 ± 3.36 | 56.2 ± 3.01 | 35.6 ± 1.71 | 26.1 ± 5.42 |
| | 70.5 ± 3.40 | 56.1 ± 2.96 | 36.0 ± 1.56 | 26.9 ± 5.08 |
| Brain hor.injection | 70.5 ± 3.40 | 56 ± 3.16 | 35.4 ± 1.83 | 25.9 ± 5.62 |
| | 75.5 ± 4.33 | 61.3 ± 4.05 | 44.5 ± 3.80 | 26.1 ± 5.34 |
| Thoracic ganglion inj. | 70.4 ± 3.59 | 56.1 ± 3.07 | 35.3 ± 1.88 | 25.7 ± 5. 96 |
| | 75 ± 4.92 | 62.4 ± 4.76 | 45.7 ± 5.20 | 26 ± 5.63 |

Table 6: Showing effect of eyestalk ablation and neuroendocrine hormones on the development of secondary sexual organs in eyestalk ablated male freshwater crab, *Barytelphusa cunicularis*.

| Treatment | Major chela length Mean ± S.D. 1st Day 21st Day | Minor chela length Mean ± S.D 1st Day 21st Day | Area of pleopod Mean ± S.D. 1st Day 21st Day | Abdomen width Mean ± S.D. 1st Day 21st Day |
|---|---|---|---|---|
| Intact control | 70.3 ± 3.33 | 56.1 ± 3.07 | 35.6 ± | 26.1 ±5.42 |
| | 71.6 ± 3.68 | 57.4 ± 3.30 | 36.5 ± 2.12 | 26.3 ± 5.31 |
| Bilateral eyestalk abl | 70.3 ± 3.33 | 55.1 ± 2.68 | 35.3 ± 1.88 | 25.4 ± 5.21 |
| | 73.7 ± 4.00 | 59.5 ± 2.95 | 37.9 ± 2.13 | 27.9 ± 5.83 |
| Eyestalk hor. Injection | 70.2 ± 3.55 | 54.9 ± 2.51 | 35.5 ± 1.71 | 26.1 ± 5.64 |
| | 70.3 ± 3.30 | 54.5 ± 2.71 | 36 ± 1.56 | 27.6 ± 4.01 |
| Brain hor.injection | 70.2 ± 3.64 | 54.7 ± 3.52 | 35.4 ± 1.83 | 25.9 ± 6.55 |
| | 74.5 ± 4.14 | 60.1 ± 4.09 | 35.5 ± 1.76 | 27.2 ± 5.59 |
| Thoracic ganglion inj. | 69.8 ± 3.15 | 54.9 ± 4.12 | 35.3 ± 1.88 | 23.6 ± 3.06 |
| | 74.0 ± 3.65 | 61.0 ± 4.85 | 37.9 ± 2.33 | 26.5 ± 6.15 |

*Eyestalk hormone injection*

When eyestalk hormone injected into normal individuals, there was increase in diameter of acini and number of acini but general weight of testis decreased (Plate-II-Fig. 3 & Table 4). When it was administrated into eyestalk less animals, there was overall reduction in the growth in the testis (Plate-II-Fig. 4 & Table 4). No major changes found in the length of secondary sexual organs in normal and eyestalk ablated male. The result showed that reduction in growth was much when compared with eyestalk ablated animals (Table 5 & 6).

*Brain hormone injection*

When brain hormone injected into the normal individuals, number and diameter of acini increased and total wet weight gonad also increased (Plate-II-Fig. 5 and Table 4). When it was injected into eyestalk less animals, rapid growth of the acini took place and total weight also increased (Plate-II-Fig. 6 and Table 4). Major and minor chela length, area of pleopod, abdomen width was increased in normal and eyestalk ablated male (Table 5 & 6).

*Thoracic ganglion hormone injection*

It resulted in overall growth of gonads into normal individuals as well as in eyestalk less crabs and both testis and diameter of acini increased (Plate -II-Fig. 7 & 8 and Table 4). It caused growth of major and minor chela but it was less when compared with eyestalk ablated female. Small growth was also recorded in pleopod and abdomen (Table 5 & 6).

## Discussion

Many workers demonstrated that ovarian maturation is regulated by a gonad inhibiting hormone (GIH) from the X-organ sinus gland complex of the eyestalks in the crustaceans [23, 4, 22] in *Scylla serrata* observed that bilateral eyestalk removal resulted in increase of ovarian weight, size and oocyte diameter. De [5] in *Eriocheir sinensis* reveled that eyestalk removal increases the rate of mitotic divisions of oogonia and number of oocytes. In *Barytelphusa cunicularis*, bilateral eyestalk ablated females ovary showed rapid maturation of oocytes, which indicated inhibitory action of eyestalk extract injection, the oogenesis was ceased and that was evident by less number of oocytes and absence of yolk droplets. Growth of abdomen and pleopod were also recorded. The destalked crabs who received eyestalk extracts showed normal oogenesis.

The testis inhibiting factor in the male crabs was reported in *P. hydrodromous* [8, 10] suggested that spermatogenesis resulted through androgenic gland. Fingerman [7] reported that male crustaceans are different from the female in that they have special endocrine glands-a pair of the androgenic glands (AG), which are correlative with differentiation and GIH and GSH promote testicular development through AG.

Testis of *Barytelphusa cunicularis* showed inhabitation to the eyestalk hormone. When eyestalk removed, advanced stages of spermatogenesis were found. In destalked males eyestalk extract injection inhibited the spermatogenesis whereas in normal males eyestalk extract caused suppressed spermatogenesis. Eyestalk ablation caused increment in the

length of major and minor chela, suggesting role of some factors associated with its development.

The presence of gonad stimulating hormone (GSH) in the central nervous system was reported previously in *Paratelphusa hydrodromous* [8] in *Potamon dehaari* [17] The Neurosecretory cells of cryfish, *Leander serratus* and *Crangon crangon* secrete hormones which maintain the spermatogenesis and androgenic gland. Touir [23, 13] in *Armadillidium vulgare* and *Porcellio dilates* stated that brain hormones control the growth of androgenic gland and synthesis of other hormones in the male. The enhancement of vitellogenesis by thoracic ganglion implants in *Libinia emerginata* [9]. Jin *et al.,*[12] with aid of co incubation stechnology stated that brain and thoracic ganglion are the sources of GSH, and they exert direct promotion over ovarian development and through AG (indirect) on spermatogenesis.

In *Barytelphusa cunicularis,* eyestalk has inhibitory principle of gametogenesis, whereas brain and thoracic ganglion hormones have stimulatory principles. The brain and thoracic ganglion hormone extract injection in destalked crabs drastically increased the wet weight of gonads and length of abdomen, pleopod and major and minor chela. The effect was much by brain hormones when compared to thoracic ganglion extract injection. The normal after receiving these hormones showed increment in the weight of gonads and size of oocytes and seminiferous tubules and effect was far more by brain hormones when compared to others. These gonads stimulating hormone (GSH), also stimulated growth of sexual characters suggesting role of some factors.

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