E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2017; 5(1): 182-185

www.fisheriesjournal.com
Received: 29-11-2016
Accepted: 30-12-2016

Showkat Hussain
Department of Zoology and Applied Aquaculture, Barkatullah University Bhopal, Madhya Pradesh, India.

Priyanka Parmar
Department of Zoology and Applied Aquaculture, Barkatullah University Bhopal, Madhya Pradesh, India.

Susan Manohar
Department of Zoology and Applied Aquaculture, Barkatullah University Bhopal, Madhya Pradesh, India.

Pooja Yadav
Department of Zoology and Applied Aquaculture, Barkatullah University Bhopal, Madhya Pradesh, India.

Correspondence
Priyanka Parmar
Department of Zoology and Applied Aquaculture, Barkatullah University Bhopal, Madhya Pradesh, India.

Effect of photoperiodism on ovarian maturation of female freshwater prawn *Macrobrachium lamarrei lamarrei* {H. M. Edwards 1837}

Showkat Hussain, Priyanka Parmar, Susan Manohar and Pooja Yadav

Abstract
The effect of photoperiodism on the ovarian maturation and ovarian indices of female freshwater prawn *Macrobrachium lamarrei lamarrei* {H. M. Edwards, 1837} was investigated in the laboratory over a period of 28 days. 90 healthy specimens of *M. lamarrei lamarrei* were taken with uniform weight (0.286-0.325gm) and length (35-40 mm). The experimental prawns were divided into three groups Viz, control, continuous dark and continuous light. The ovarian maturation was assessed by microscopic and histological observations. G.S.I (ovarian indices) of all the 3 groups has been calculated. The result from this study revealed that in continuous dark the ovaries are in more developed conditions as compare to control and continuous light. The GSI revealed after the study shows marked difference as that of control group. Therefore, it was concluded that complete darkness is useful to accelerate ovarian maturation in *M. lamarrei lamarrei.*

Keywords: Photoperiodism, ovarian maturation, GSI

1. Introduction
It is worldwide known fact that in today's era the rate of commercial crustacean fisheries is declining. Major factors that are contributing in declining crustacean population include inadequate legislation, increases in the harvest rate, decrease in the size of the crustaceans, destruction of breeding ground and progress in worldwide usage. Alternative for enhancing the crustacean populations for consumption is by manipulating the reproductive capacity of the individual, thereby increasing the maturation period. Ovarian maturation of crustacean is controlled by both internal and external causes. The external cause includes temperature, photoperiod, food availability and salinity; they all have great influence on reproductive performance [1].

Photoperiodism is known to affect the behavior and physiology of crustacean [2]. Reproductive cycle of crustacean species controlled by temperature and photoperiod since those are important exogenous factor enhancing growth of organisms [3]. Moulting and growth of freshwater prawn *M. dayanum* stimulated by temperature and photoperiod [4]. Photoperiod also regulates the timing of ovarian growth. In freshwater crab, *Oziotelphusa senex senex*, increased light hours accelerated the ovarian cycle of maturation [5], whereas in *Penaeus merguiensis* dim light promoted ovarian maturation [6]. Endogenous causes include both neuroendocrine and non-neuroendocrine secretions. A number of hormones from neuroendocrine organs play an important role in controlling gonad maturation in crustacean [7, 8, 9]. Gonad maturation in crustaceans principally regulated by two antagonistic neuropeptides. Gonad-inhibiting hormone (GIH), also called vitellogenesis-inhibiting hormone (VIH), which is synthesized in the X-organ of the eyestalk and stored in the sinus gland (SG) of the eyestalk and finally released into hemolymph in decapod crustaceans [10, 11, 12, 13] and gonad stimulating hormone (GSH), which is produced by the brain and thoracic ganglion. Besides these, methylfarnesoate and ecdysteroids secreted by mandibular organs and Y-organs respectively this also control female reproduction [8]. Hence an attempt was made in present experiment to demonstrate the effect of light and dark condition on the ovarian maturation of *M lamarrei lamarrei.*

2. Material and Methods

Live freshwater prawns *Macrobrachium lamarrei lamarrei* were collected from Upper Lake, Bhopal and brought to the laboratory. Before experimentation, prawns were treated with 0.1 $KMnO_4$ solution to obviate any dermal infection and acclimatized in the laboratory for 3 days. Experiment was conducted in triplets where prawns were kept in glass aquarium (55 L) and fed with commercially available food. The excess feed and fecal matter has been siphoned out every day to avoid contamination of the water. The water is change after 5 days .90 specimens of *M. lamarrei lamarrei*, looking apparently healthy, in the size group of 35-40 mm in total length, with uniform ovarian condition (immature) were selected for the experiment. The total duration of the experiment investigated in the laboratory was 28 days. The experimental Prawns were divided into the following three groups each having 30 animals.

Group A

Normal or control: This group was subjected to natural day and night with normal duration and intensity.

Group B

These prawns are kept in 24hrs. complete darkness. They were placed in an aquarium which covered with thermocol frame and further covered the whole aquarium with a black paper sheet, in order to maintain animals in constant darkness throughout the experimental work.

Group C

Animals receive 24 hrs. of light every day. Lighting was provided by 15 watt yellow light producing bulb suspended from a thermocol frame approximately 7 inches above the water level, to prevent the temperature change of water.

Fig 1: Experimental set up of Group A, Group B and Group C in Laboratory.

1.2 Histological procedure and estimation of gonadotropin somatic indices

Various parameters which were studied for estimation of ovarian development include coloration of ovary, ovarian index and oocyte diameter. The oocyte dimensions were determined with the aid of oculometer. Female reproductive functions were determined by measuring ovarian indices and histological studies of ovaries. After the completion of the experiment, prawns from both control as well as experimental groups were measured by means of scale for total length and weighted and then sacrificed for the gonads (ovaries). Ovaries were then weighed and processed for histological studies. Paraffin blocks of ovaries were prepared and sections were cut at 6-7µm in thickness, stained by hematoxylin and eosin stain. Ovarian sections were examined under compound microscope.

The gonadal indices were determined using the standard formula.

$$\text{Ovarian index (OI)} = \frac{\text{Wet weight of the gonads}}{\text{Live weight of the whole animal}} \times 100$$

Statistical analysis was subjected to one way ANOVA.

2. Result

After 28 days of experiment, various observation of the present study was made as follows:

Group A: The prawn served as control, in which lowest ovarian indices value 0.68 ± 0.011 was recorded (Table.1). Histological observation of ovaries showed predominance of oogonial cells (Og) and pre-vitellogenic oocytes (PO) near germinal zone (Fig. 2). They are basophilic in nature. Lowest mean oocytes diameter value 75.50 ± 13.84µm is observed in this group (Table 1).

Group B: This group was exposed to 24 hrs. of complete darkness. Highest ovarian indices recorded as 1.59 ± 0.043 in this group as compared to control and continuous light group (Table 1). Histological observation of group B showed large number of post-vitellogenic oocytes (Fig. 3). Yolk deposition is almost completed in all these oocytes and whole of the ooplasm upto perinuclear region which get occupied by yolk globules. The entire cytoplasm becomes eosinophilic. Highest oocytes diameter value 332.65 ± 21.98 µm is recorded in Group B, subjected to complete darkness (table 1).

Group C: This group exposed to 24 hrs. continuous light and showed intermediate value of ovarian indices and oocytes diameter 1.25 ± 0.027 and 128.56± 28.56µm respectively (Table 1). Histological observation of group C shows predominance of vitellogenic oocytes (VO) Ooplasm of these oocytes is granular, small yolk vacuoles have been observed to make their appearance in the periphery of ooplasm of the oocytes (Fig. 4). Nucleus stain bluish with haemotoxyline, which is centrally located, increases in size and had a wavy nuclear membrane. Small round follicular cells around oocytes have been observed.

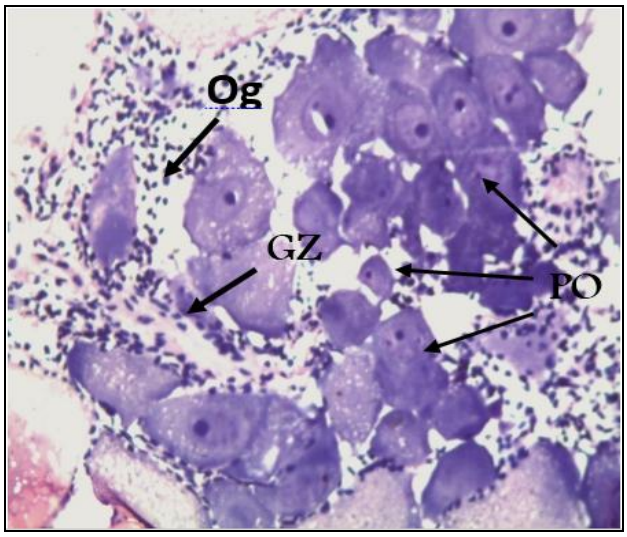

Fig 2

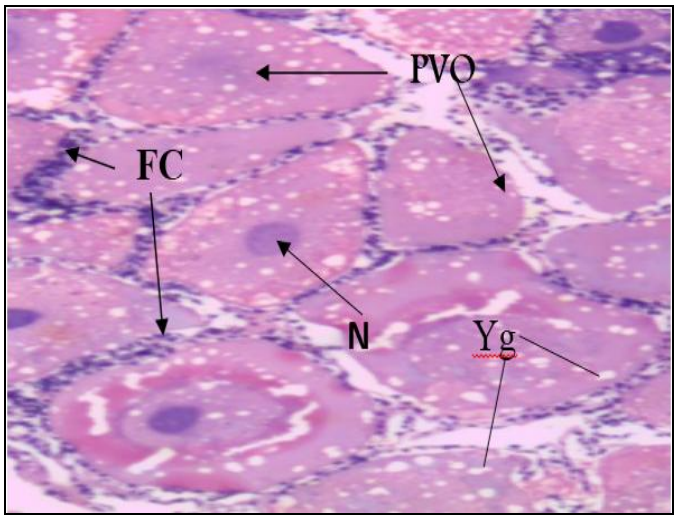

Fig 3

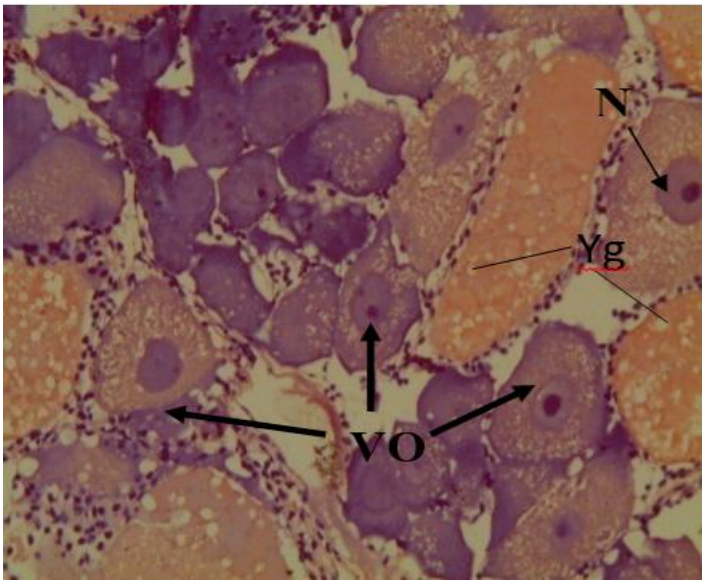

Fig 4

Fig. 2, 3 & 4 showing the ovarian maturation stages in freshwater female prawn, *M. lamarrei lamarrei* in control, complete darkness and complete light respectively (showing germinative zone and pre-vitellogenic oocytes in Fig. 2, Post-vitellogenic oocytes in Fig. 3 & in Fig. 4 showing Vitellogenic oocytes)**.** H & E Stain

Og= Oogonia, Gz= germinative zone, PO= pre-vitellogenic oocyte, VO= vitellogenic oocyte, N= nucleus, FC= follicular cells, Yg = yolk globules, PVO = post-vitellogenic oocyte.

And after applying one way ANOVA, treatments differ significantly ($P < 0.05$).

Table 1: Showing the effect of photoperiodism on coloration of ovary, ovarian indices and oocytes diameter.

	Animal Group	Colour of the ovary	Ovarian Indices ±SD	Oocytes diameter(µm) ±SD
Group-A	Control	Translucent	0.682±0.011	75.50 ± 13.84
Group- B	24 hrs. Complete Dark	Greenish	1.59±0.043	332.65 ± 21.98
Group-C	24 hrs. Complete Light	Yellowish White	1.25±0.027	128.56 ± 28.57

3. Discussion

In present study prawns being subjected to complete darkness are similar to eyestalk ablated specimen, as in both the case the main aim is to keep the optic ganglion from being exposed to light. Therefore, the observation made in both the cases exhibited almost similar results.

In the present investigation, development of size of ovary and formation of fully mature oocytes *i.e.* post-vitellogenic oocytes are seen in the ovaries of prawns subjected to complete darkness in comparison to that of the control group where mostly oogonial cells are abundantly seen. This is attributed due to decrease in the activity of neurosecretory cells of the optic ganglion in the eyestalk in the absence of light. At the same time the prawns subjected to complete light exhibited lesser development in the ovary in comparison to prawns kept in complete dark. This may be due to increased activity of the neurosecretory cells in the eyestalk in the presence of continuous light. The present study clearly demonstrated that ovarian maturation of *M. lamarrei lamarrei* was inhibited by 24 hrs. light condition and promoted by 24

hrs. dark condition. The ovarian indices and oocytes diameter values were also higher than as compare to 24 hrs. Complete light group and control group.

[14, 15] observed increase in the gonadal somatic index, after the eyestalk ablation in *M. dayanum* which indicated increased reproductive activity due to the removal of the gonad inhibiting hormone present in the X-organ of the eyestalk. The bilateral eyestalk ablation resulted in the accelerated gonadal development both in the males and females. It was also suggested that the removal of the eyestalks has accelerated the gonad development, it was stated that the eyestalks of *M. dayanum* contain, the gonad inhibitory factor, the supply of which ceases by the removal of the eyestalk, thereby increasing the activity of gonad development. The study tends support to the results seen in the present studies. The study done by [16] reported an increase in G.S.I and ova diameter in unilateral ablated female *M. rosenbergii*. [17] also observed highest GSI value in eyestalk ablated female. Hence it is finally concluded that the ovarian maturation can be easily attained by simply keeping the prawns in dark rather than subjected them to eyestalk ablation which is a permanent blinding practice.

4. Acknowledgement

Special thanks to Head of Department, Department of Zoology and Applied Aquaculture, Barkatullah University, Bhopal, Dr. Ashok Kumar Munjal, for logistic support and laboratory availability, at the Department, for conducting research works in zoology.

5. Reference

1. Adiyodi KG, Adiyodi RG. Endocrine control of reproduction in decapod crustacea. Biol. Rev. Camb. Philos. Soc., 1970; 45:121-165.
2. Bishop JM, Herrnkind WF. Buying and molting of pink shrimp, *Penaeus duorarum* (crustacean: penaeidae), under selected photoperiods of white light and UV-light. The Biol. Bull., 1976; 150:163-182.
3. Meusy JJ, Payen GG. Review: Female reproduction in Malacostracan crustacean. Zool. Sci., 1988; 5:217-265.
4. Pervaiz PA, Susan M. Studies on the effect of photoperiodism and temperature on moulting of a freshwater prawn *Macrobrachium dayanum.* Int. J Fish. Aquat. Stud., 2015; 3:325-328.
5. Kumaran T, Devakumar D, Jayanthi J, Ragunathan MG. Effect of photoperiodism, Eyestalkablation on the ovarian development and electrolytic changes in a freshwater crab, *Oziotelphusa senex senex.* Int. J Curr. Res. Biosci. Plant Biol., 2015; 2:130-135.
6. Houng T, Lee SY, Keenan CL, Marsden GS. Ovarian maturation of the banana prawn, *Penaeus merguiensis* de Man under different light intensities. Aquaculture. 2002; 208:159-168.
7. Chang E, Chang S, Mulder E. Hormones in the lives of crustaceans: an overview. Am. Zool., 2001; 41:1090-1097.
8. Nagaraju GPC. Is methyl farnesoate a crustacean hormone? Aquaculture. 2007; 272:39-54.
9. Nagaraju GPC. Reproductive regulators in decapod crustaceans an overview. J. Exp. Biol., 2011; 214:3-6.
10. Bocking D, Dircksen H, Keller R. The crustacean neuropeptides of the CHH/MIH/GIH family: structures and biological activities. In: Wiese, K (Ed), the crustacean nervous system. Springer, Heidelberg. 2002, 84-97.
11. Nagaraju GPC, Prasad GLV, Reddy PS. Isolation and characterization of mandibular organ inhibiting hormone from the eyestalks of freshwater crab, *Oziotelphusa senex senex*. Int. J. Appl. Sci. Eng., 2005; 3:61-68.
12. Ollivaux C, Vinh J, Soyez D, Toullec JY. Crustacean hyperglycemic and vitellogenesis-inhibiting hormones in the lobster *Homarus gammarus.* FEBS J. 2006; 273:2151-2160.
13. Chang ES, Mykles DL. Regulation of crustacean molting: a review and our perspectives. Gen. Comp. Endocrinol. 2011; 172:323-330.
14. Biswas R. Development biology and correlative cycle changes in the neurosecretory cells and gonads of freshwater prawns *Macrobrachium dayanum*. Ph. D. Thesis, B.U. Bhopal, India, 1991.
15. Pervaiz PA, Sikdar M. Influence of bilateral eyestalk ablation of gonads of freshwater prawn, *Macrobrachium dayanum.* J Env. Biol., 2014; 35:821-825.
16. Pandey AK, Kumar A. Effect of unilateral eyestalk ablation on ovarian maturation, neurosecretory cells of brain and thoracic ganglia of giant freshwater prawn *Macrobrachium rosenbergii* De Man. Proc. Int. Symp. Freshwater Prawns. 2007, 508-517.
17. Gupta AK, Roy D. Suggestive role of eye-stalk of *Macrobrachium gangeticum* Bate, 1868 in regulation of its reproductive behavior. J Indian Fish. Assoc., 2009; 36:41-46.