EFFECT OF EYE-STALK ABLATION ON COLORATION IN PRAWN MACROBRACHIUM DAYANUM

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ABSTRACT

The present investigations were conducted to evaluate the effect of eyestalk ablation on coloration in fresh water prawn Macrobrachium dayanum from Jammu water bodies. Prawns collected from Ghomanhasan stream were divided into three groups viz, unablated, uni-laterally ablated and bi-laterally ablated prawns. These were examined on weekly basis for the chromatophore index. It was observed that chromatophore index increases both in uni-laterally ablated prawns (UEA) and bi-laterally ablated prawns (BEA) prawns. Bi-laterally ablated prawns (BEA) prawns yield better results than unablated and uni-laterally ablated prawns (UEA). The reason behind this advancement in chromatophore concentration in BEA is due to absence of both eye-stalks, because eye-stalk of prawn have PDH hormone, which is secreted by the sinus gland & supra-oesophageal ganglion. As bilateral ablation removes both the eye-stalks in prawns, no pigment dispersing hormone (PDH) hormone is released, which leads to the concentration of pigments in the carapace and these prawns appear dark and colored in appearance as compared to UEA prawns which has one eye-stalk intact and control group where both the eye-stalks were intact. ANOVA demonstrate that the treatments differ significantly at 1% level of significance (P<0.01) and maximum difference is between control & BEA prawns. Chromatophore index differ significantly at 1% level of significance and the maximum difference is between initial and 10th week.

INTRODUCTION

Changes in crustacean colouration can be due to physiological or morphological mechanisms. Physiological mechanisms that influence prawn colour include carotenoid availability in the diet, background substrate colour, photoperiod, light intensity and temperature (Rao, 1985). Such colour changes are often rapid, reversible and rhythmic, and are associated with hormonally controlled expansion and contraction of pigment structures, known as chromatophores, contained within the hypodermal layer, the pigmented layer in between the exoskeleton and abdominal muscle (Fingerman, 1966; Rao, 1985; Rao, 2001).
Chromatophores strongly influence crustacean color, particularly in prawns that have thin, opaque shells. Pigmentary effectors enable crustaceans to display rapidly reversible integumental color changes and retinal screening pigment movements. Color changes result from dispersion or concentration of pigment granules within epithelial chromatophores.

Several studies made by many earlier scientists (Perkin, 1928 and Koller, 1928) as well as during recent period (Almada et al. 2005); Moles and Luisa, (2006) showed that pigmentary changes in the decapod crustacean is under the control of an endocrine substance that had its origin in the eye-stalks. Koller (1927); Perkins(1928); Klienholz (1934) and Fingerman (1955) reported the hormonal involvement in the control of pigment movements in crustacean chromatophores. Fingerman (1963,1969,1970,1985,1988) and Finger et al. (1994) contributed towards the elucidation of the regulation of crustacean pigmentary effectors especially in areas such as localization and differentiation of pigmentary-effector hormone, role of biogenetic amines in hormone release and cellular mechanism of hormone action. Fingerman and Bartell (1969); Rao et al.(1985) and Fingerman (1988) reported that the total number of pigmentary-effector hormones present in any species remains unknown but they can be differentiated into two sets. The hormonal triggering chromatophoral pigment dispersion and ommatidial light adaptation belong to one set and these are different from those responsible for chromatophoral pigment concentration and ommatidial dark adaptation. Skarkowskii (1971) and Fingerman (1973) investigated the gel filtration chromatography of eye-stalk extracts and formed two distinct zones of pigment concentrating activity. Fernlund and Josefsen (1972) reported that red pigment concentrating hormone (RPCH) is an octapeptide and first identified from the eye-stalk of Pandulus borealis. Klienholz (1975) reported that peptide triggers not only light adaptational screening pigment movements in the eye-stalk but also pigment dispersion in chromatophores and referred later as α-PDH(Pigment dispersing hormone).

Rao et al. (1985) identified β-PDH as the major form of pigment hormone in eye-stalk of Uca pugilator. Klienholz et al. (1986) reported β-PDH in the brachyuran crab, Cancer magister. Phillips et.al (1988) reported the major PDH (Leu8, Ile11)-β-PDH in the shrimp Penaeus aztecus.

Rao and Rehman (1989) identified that the multiple forms of PDH within an individual species has been accomplished by sequencing of purified peptide as in Pandanus jordani. Several other workers studied the β-PDH in different species of crustaceans notable among them are Klienholz et.al (1992); Lohar et.al (1993) (Carcinus maenas); Rao and Rehman.
Rao and Rehman (1993) studied the crayfish and reported major forms of β-PDH in Pacifastacus leniusculus. Klienholz et al. (1995) worked on Callinectus sapidus for red pigment concentrating hormone and also reported the molecular cloning. Rao (2001) reported integumentary color changes and eye-stalk pigment movements in crustaceans is regulated by pigmented effector hormones. The identified hormone included an octapeptide RPCH and several forms of octapeptide PDH, i.e., α-PDH. Almada et al. (2005) and Moles and Perkins (2006) showed that pigmentary changes in the decapod crustacean is under the control of neuro-endocrine substance that has its origin in eye-stalks. Wade et al. (2008, 2009) studied that chromatophores strongly influence crustacean colour, particularly in prawns that have thin, opaque shells. Morphological mechanisms that influence prawn colour, in contrast, are considered to involve quantitative modifications of exoskeletal pigment concentration or composition, and hence are thought to be slower and more permanent. These changes have been associated with particular crustacean life history stages or interspecific differences in colour and patterning.

**Material and Methods**

**Collection area:** Experimental organisms Prawn, Macrobrachium dayanum and Fish, Puntius sophore were collected from their natural habitat from a stream at Gho-Manhasan situated at 32° 67’ Lat N; 74° 79’ Long E located at a distance of 20 km north west of Jammu city.

**Method of collection**
Monthly collections were made with the help of rectangular haul / sweep net with 1620 cm sq. mouth area (1mm mesh size) and 80 cm long during morning hours (8:00-12:00). Most of the live specimens were collected from Gho-Manhasan stream because of easy access and availability in abundance throughout the year. Since stream is located at a short distance therefore, live specimens could be brought safely to the laboratory with less stress. During the catch operations, net was manually dragged up to a distance of 10-15 feet and the entrapped individuals were transferred to the bucket filled with stream water. Live specimens were then brought to departmental laboratory, where they were kept in plastic troughs.
Acclimatization
Captured live specimens were acclimatized in the laboratory plastic troughs at room temperature for about 10-15 days before the start of experiment. These plastic troughs were provided with aerators.

Five prawns in each set with duplicate were examined weekly for chromatophores. Chromatophores of different colors were observed in different stage ranges from 1st to 5th stage. A comparative study of chromatophores have been carried out on weekly basis by counting the chromatophores of unablated and ablated prawns under the stereo microscope and chromatophore index was calculated by using the formula:

\[ C.I = C.S \times C.NO. \]


Results and Discussion
The persual of the table reveals that three groups of prawns bilaterally ablated (BEA) & unilaterally ablated (UEA) and control group were examined every week for their chromatophore index, chromatophore index of BEA, UEA & control prawns after 2 weeks were 41.33±2.00, 40.00±2.00 & 36.66±1.15. Chromatophore index of all three groups observed after third week was 46.66±1.55 for group A 43.66±2.51 for group B & 37.33±2.30 for group C. After fifth week the chromatophore index for group A, B & C was 50.33±1.52, 49.33±1.52 & 40.66±3.05 respectively. When the groups were investigated after 10th week the chromatophore index for group A group B & group C (Control) were 61.66±1.52, 55.33±1.52 & 49.33±1.52 respectively. Chromatophore index observed after 12th week for group A, B & C were 66.33±1.52, 60.33±1.52 & 51.00±2.64 respectively.

The results observed during the experiment were compared to the control group and varied significantly and there is no significant difference in UEA and BEA prawns.

ANOVA demonstrate that the treatments differ significantly at 1% level of significance (P<0.01) and maximum difference is between control & BEA prawns. Chromatophore index differ significantly at 1% level of significance and the maximum difference is between initial and 10th week. Results also demonstrate that with the advancement of time period chromatophore indices increases in both BEA & UEA prawns. In present study it is observed that BEA prawns yield better results than the control. The reason behind the maximum chromatophore in BEA is due to the absence of eye-stalk because eye-stalk of prawns have pigment dispersing hormone which is released by the sinus gland & supraoesophageal
ganglion, as bilateral ablation removes both the eye-stalks in prawns, no PDH hormone is released, which leads to the concentration of pigments in the carapace and these prawns appear dark and colored in appearance as compared to UEA prawns which has one eye-stalk intact and control group where both the eye-stalks were intact. The results of the present study agreed with the views of Rao et.al 1985 while studying on the PDH in eye-stalk of Uca pugilator. Hormonal control system of color changes in crabs have been studied by the Quackenbush, 1981; McNamara & Riberio, 2000; Granto et.al 2004; Thurman, 1988. Views of several workers (Fingerman, 1965, 1970; Jhonson, 1974; Willmer et.al, 2000; Endler, 2006 and Stevens, 2007) on background adaptation in several crustacean species do support the present investigation, effect of background on coloration in freshwater prawn Macrobrachium dayanum.

Table 1.1. Effect of eye stalk ablation on chromatophore in M. dayanum.

<table>
<thead>
<tr>
<th>WEEKS / PRAWNS</th>
<th>Control</th>
<th>UEA</th>
<th>BEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1ST WEEK</td>
<td>35.33±0.57</td>
<td>35.33±0.57</td>
<td>35.33±0.57</td>
</tr>
<tr>
<td>2ND</td>
<td>36.66±1.15</td>
<td>40.00±2.00</td>
<td>40.00±2.00</td>
</tr>
<tr>
<td>3RD</td>
<td>37.33±2.30</td>
<td>46.66±2.51</td>
<td>46.66±2.51</td>
</tr>
<tr>
<td>4TH</td>
<td>38.00±2.00</td>
<td>48.00±1.00</td>
<td>48.00±1.00</td>
</tr>
<tr>
<td>5TH</td>
<td>40.66±3.05</td>
<td>50.33±1.52</td>
<td>50.33±1.52</td>
</tr>
<tr>
<td>6TH</td>
<td>41.33±2.30</td>
<td>54.00±1.73</td>
<td>54.00±1.73</td>
</tr>
<tr>
<td>7TH</td>
<td>45.66±1.52</td>
<td>50.33±2.08</td>
<td>58.00±1.73</td>
</tr>
<tr>
<td>8TH</td>
<td>46.33±0.57</td>
<td>51.33±2.51</td>
<td>60.33±1.52</td>
</tr>
<tr>
<td>9TH</td>
<td>48±1.00</td>
<td>52.66±2.08</td>
<td>60.33±2.08</td>
</tr>
<tr>
<td>10TH</td>
<td>49.33±3.21</td>
<td>54.33±1.52</td>
<td>60.66±1.52</td>
</tr>
<tr>
<td>11TH</td>
<td>49.33±2.08</td>
<td>58.33±1.52</td>
<td>64±1.73</td>
</tr>
<tr>
<td>12TH</td>
<td>51±2.64</td>
<td>60.33±1.52</td>
<td>66.33±1.52</td>
</tr>
</tbody>
</table>

M±SD= Mean Chromatophore index, Standard Deviation.
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References