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Photoperiod Influences on Molting Cycle and Maturation of the Prawn *Penaeus japonicus*

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Abstract

Effects of the long (14h light, 10h dark; 14L10D) and short day-lengths(01L23D) were investigated for the molting cycle and gonad development of the prawn *Penaeus japonicus*. Individual rearings of 30 young prawns were carried out from April to July under each photoperiod. During the 90 days rearing, the molting day and the carapace length of exuviae were recorded individually. After the experiment, the days required for every molting cycle and the gonadosomatic index (GSI) of each prawn were calculated. From a result of insignificant differences of their GSI and the length of the molting cycle between both groups, it was deduced that the molting and maturation mechanisms of the prawn would not be affected at its young stage by the environmental photoperiod.

There have been some trials to control the growth and maturation of the prawns, crayfish and spiny lobster by changing environmental factors as temperature and/or photoperiod. It was achieved to mature and induce spawning of the adult prawns *Penaeus japonicus* [1),2)] and *P. esculentus*[3)] under a long day-length and warm temperature. However, there exists a completely negative or passive report of those factor's direct participation in the mechanisms for the adult crayfish *Orconectes nais*[4)] or spiny lobster including sub- and adult *Panulirus argus*[5)]. Present experiment treats of the investigation of the environmental participation in the molting and gonad development of the prawn *P. japonicus* during its young stage.

Materials and Methods

The 10-15g young prawns, *Penaeus japonicus*, brought from the culture farm were separated individually in 60 tanks of 18*l* volume. They were divided into two groups under different photoperiods as long and short day-lengths. The long day-length was 14h light of 1500-2000lx at 6:00-20:00. The short day-length of 1h light was maintained at 9:00-10:00 with the same light intensity as that of the long day-length, covering the tanks with black sheets during the dark condition. Each photoperiod was expressed as 14L10D or 01L23D, respectively. Feeding time of each group was 20:00 and pellets were given. Water

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temperature was resigned to the room condition. The experiment was undertaken from April to July. During the 90 days rearing, water temperature, molted individuals and the carapace length of their exuviae were recorded. For maintenance of water quality, tank water was exchanged regularly within at the light time. After the experiment, the days required for every molting cycle and the gonadosomatic index (GSI, gonad wt. x100/body wt.) of each prawn were calculated.

Results and Discussion

Water temperature during the experimental period was shown in Fig. 1. It had a range from 20℃ to 29℃ and an increasing tendency. For the prawn growth, therefore, the condition of temperature was admitted to have been suitable. The molting frequency of each photoperiod was also exibited in Fig. 1. Daily changes of the value did not show any pattern

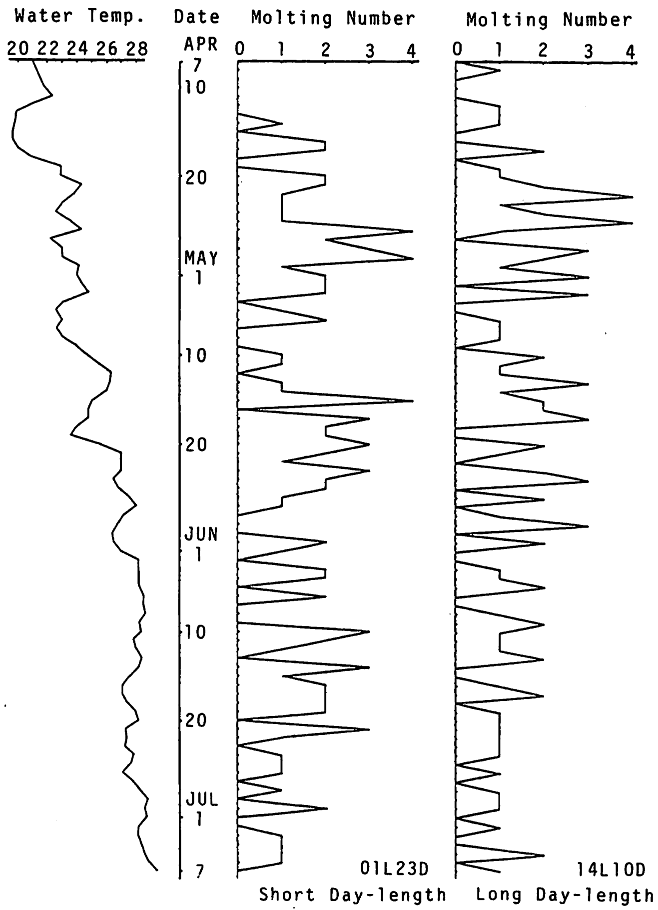

Fig. 1 Daily changes of water temperature and number of molted prawns under the 14L10D or 01L23D photoperiod.

Table 1 Carapace length (mm) of the exuviae and molting cycle (day) of individually molted prawns under the 14L10D or 01L23D photoperiod.

Long Day—length 14L10D			Short Day—length 01L23D		
Specimen No.	Carapace length	Molting cycle	Specimen No.	Carapace length	Molting cycle
101	30.0	17	201	30.5	23
102	30.5	17	202	30.5	27
103	31.0	19	203	31.0	16
104	31.0	20	204	31.0	21
105	31.0	23	205	31.0	21
106	31.0	24	206	31.0	21
107	31.5	18	207	31.0	21
108	31.5	19	208	31.5	17
109	31.5	20	209	31.5	21
110	31.5	22	210	31.5	21
111	31.5	25	211	31.5	22
112	31.5	32	212	31.5	22
113	32.0	16	213	31.5	28
114	32.0	21	214	32.0	15
115	32.0	21	215	32.0	18
116	32.0	22	216	32.0	20
117	32.0	23	217	32.0	20
118	32.0	28	218	32.0	20
119	32.0	33	219	32.0	22
120	32.0	35	220	32.0	23
121	32.5	18	221	32.0	23
122	32.5	18	222	32.0	24
123	32.5	19	223	32.0	28
124	32.5	21	224	32.0	28
125	32.5	22	225	32.5	17
126	32.5	23	226	32.5	18
127	32.5	23	227	32.5	19
128	32.5	24	228	32.5	24
129	32.5	24	229	32.5	25
130	32.5	26	230	32.5	25
131	32.5	27	231	33.0	16
132	32.5	27	232	33.0	17
133	33.0	16	233	33.0	18
134	33.0	19	234	33.0	19
135	33.0	19	235	33.0	19
136	33.0	23	236	33.0	19
137	33.0	23	237	33.0	20
138	33.0	25	238	33.0	20
139	33.0	25	239	33.0	20
140	33.0	25	240	33.0	22
141	33.0	29	241	33.0	22
142	33.5	19	242	33.0	25
143	33.5	23	243	33.0	25
144	33.5	24	244	33.0	26
145	33.5	24	245	33.5	19
146	33.5	26	246	33.5	21
147	33.5	26	247	33.5	23
148	33.5	33	248	33.5	24
149	33.5	34	249	33.5	24
150	34.0	19	250	33.5	24
151	34.0	21	251	33.5	25
152	34.0	21	252	33.5	25
153	34.0	21	253	33.5	26
154	34.0	22	254	34.0	18
155	34.0	23	255	34.0	20
156	34.0	25	256	34.0	21
157	34.0	30	257	34.0	21
158	34.0	31	258	34.0	22
159	34.5	23	259	34.0	22
160	34.5	26	260	34.0	23
161	35.0	20	261	34.0	24
162	35.0	27	262	34.5	19
163	35.0	27	263	34.5	19
164	35.0	28	264	34.5	24
165	35.5	19	265	34.5	26
166	36.5	27	266	34.5	26
167	–	–	267	34.5	28
168	–	–	268	34.5	28
169	–	–	269	35.0	23
170	–	–	270	35.0	24
171	–	–	271	35.5	24
172	–	–	272	36.0	18
173	–	–	273	36.0	21
174	–	–	274	36.0	26
175	–	–	275	36.5	21
Mean		23.5			22.0
SD		4.47			3.20

Table 2 Sex difference (f, female; m, male) and gonadosomatic index (GSI) of individual prawns under the 14L10D or 01L23D photoperiod.

	Long Day – length 14L10D		Short Day – length 01L23D	
Indiv. No.	Sex	GSI	Sex	GSI
1	m	0.72	m	0.55
2	m	0.50	m	0.60
3	m	0.60	m	0.54
4	m	0.47	m	0.55
5	m	0.44	m	0.62
6	m	0.61	m	0.58
7	m	0.65	m	0.70
8	m	0.52	m	0.53
9	m	0.59	m	0.64
10	m	0.70	m	0.68
11	f	0.36	m	0.52
12	f	0.66	m	0.66
13	f	0.56	m	0.63
14	f	0.58	m	0.71
15	f	0.54	m	0.65
16	f	0.50	f	0.60
17	f	0.56	f	0.44
18	f	0.30	f	0.45
19	f	0.35	f	0.37
20	f	0.64	f	0.40
21	f	0.68	f	0.39
22	f	0.70	f	0.30
23	f	0.46	f	0.55
24	f	0.38	f	0.62
25	f	0.32	f	0.40
26	f	0.36	f	0.31
27	f	0.56	f	0.68
28	f	0.35	f	0.72
29	f	0.54	f	0.36
30	f	0.52	f	0.48
Mean		0.524		0.541
SD		0.123		0.124

of regularity, and there was no significant difference between patterns of the 14L10D and 01L23D. Their values of the molting frequency were 66 and 75 as a sum. Each molting cycle of the 14L10D or 01L23D was calculated as 23.5±4.5 or 22.0±3.2 (mean±S.D.), respectively as shown in Table 1. It would be recognized that the higher values were computed in the long day-length group. This lengthening of the molting cycle seemed to be only due to the light factor, because of almost same constituents of the size between both groups (see the carapace length in Table 1). However, this effect seemed to be too few considering the 23h difference of the light time. Light effect on the gonad development of both groups was presented as the GSI value in Table 2. Mean values (±S.D.) of the GSI of the 14L10D and 01L23D were 0.52±0.12 and 0.54±0.12, respectively. There existed no significant difference between them.

The above results would indicate that the physiological mechanisms of the molting and gonad development of the prawn *P. japonicus* are not affected principally at least during its young stage by the environmental factor as the day-length, that is, photo-periodism. For the adult prawns, however, the achievements of environmental control of the maturation and spawning in *P. japonicus*[1,2] and *P. esculentus*[3] were reported. Those optimum conditions were 24-26 ℃ warm temperature and 14.5-14.75h long day-length. Contrary to such adult prawns, the adult crayfish *Orconectes nais*[4] did not show a significant difference of the molting cycle and gonad development among 14L10D, 8.5L15.5D and natural photo-periods. Some similar results as that of the crayfish were shown in the sub- and adult spiny lobsters *Panulirus argus*[5]. For the latter, however, it was concluded that the day-length would behave like a parameter depending to the physiological and environmental function which participates with other parameters as the age, sex, career, temperature, season and so on, in the molting and maturation mechanisms. This apt conclusion seems to be appropriate also for the case of the prawn *P. japonicus*.

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