Length-weight relationship and condition factor of Pacific whiteleg shrimp (*Litopenaeus vannamei*, Boone, 1931) cultured in polyethylene lined pond

SD Prajapati and NC Ujjania

**Abstract**

Pacific whiteleg shrimp *Litopenaeus vannamei* (Boone, 1931) cultured worldwide with developments and revolutions in culture ponds like spread polyethylene liner over earthen ponds. The length-weight relationships in shrimp, *Litopenaeus vannamei* was evaluated cultured in polyethylene (PE) lined ponds from Bhimpore village of Surat district (Gujarat). For this purpose, 500 specimens from pond were collected during 2021 and their length and weight were recorded as per the standard methods. The length and weight were noted 11.488-15.581 (13.39±0.035) cm and 12.26-31.22 (19.61±0.162) gm during study. The noted length frequency distribution for length group A-23, for B-377 and for C-100. The recorded correlation coefficient ($r^2$) of the shrimp were 0.633 (A), 0.780 (B), 0.809 (C) and 0.906 (pooled) noted. The growth constant or regression coefficient ($b$) was observed 2.541, 2.812, 3.531 and 2.997 for length group A, B, C and pooled population. The growth constant depicted that growth of shrimp was isometric ($b$=3.0) and normal. A mean Fulton's condition factor value noted 0.808 (±0.002). These findings are clearly indicating that the growth of studied shrimp was normal and good in the polyethylene (PE) lined pond.

**Keywords:** Shrimp (*Litopenaeus vannamei*), length weight relationship, Fulton's condition factor (K), PE lined pond

**Introduction**

Shrimps consumption demanded around the world and to achieve the required production to attain the increasing demand of shrimp farming is goingon in many countries. Therefore, comparatively high export rated penaeid shrimp *Litopenaeus vannamei* cultured worldwide (Suriya *et al.*, 2016; Khademzadeh and Haghi, 2017) with expected benefits of species like specific pathogen free (SPF), specific pathogen resistance (SPR), fast growth rate and easy to culture even with high dense stocking. In Gujarat, it was introduced during 2001-02 when farmers met enormous economic losses in tiger shrimp’s (*Penaeus monodon*) culture owing to several infectious diseases. The developments and innovations in shrimp farming was implemented to enhance the shrimp production i.e. spread polyethylene liner over earthen pond to reduce seepage, maintain pH fluctuation in the water without directly contact with soil, and maintain sludge etc.

The effective production of shrimp is respite on physico-chemical and biological parameters but it could be monitored by length-weight relationship (LWR) and condition factor (K). The length-weight relationships is modestly substitute to evaluate body weight as of length measurements which is not as much of variable and further easily measured in the field (Gautam *et al.*, 2014) are enormously valuable tools for considerate the biological fluctuations in aquatic organisms (Shah *et al.*, 2013; Gautam *et al.*, 2014; Prajapati and Ujjania, 2021) The length-weight relationship has important role in fisheries science to regulate conceivable variances between diverse stocks of the same species (King, 2007) explain the comparative growth studies (Peixoto *et al.*, 2004).

The value of condition factor (K) is an index value which indicate the interaction among living and non-living factors in the biological condition of the aquatic organisms and calculated from the weight and length (Lizama *et al.*, 2000; Solanki *et al.*, 2020) It can be used to estimate changes in nutritional condition (Lizama *et al.*, 2000; Sutton *et al.*, 2000; Lalrinsanga *et al.*, 2012; Mohanty *et al.*, 2015; Solanki *et al.*, 2020; Prajapati and Ujjania, 2021). The developments and innovations in shrimp farming was implemented to enhance the shrimp production i.e. spread polyethylene liner over earthen pond to reduce seepage, maintain pH fluctuation in the water without directly contact with soil, and maintain sludge etc.
In cultured farms, it helps to assess health and habitat conditions such as food accessibility (Hanson and Bajajliya, 2005; Khademzadeh and Haghi, 2017)[15,7]. The study on length-weight relationship and condition factor (K) are important tool to understand the culture conditions, growth status and condition of shrimp consequently, present study was conducted.

Material and Methods
The morphometric variables including length and weight of randomly collected 500 specimens of shrimp were measured from catch of polyethylene lined pond at Bhimpore, Surat (Gujarat) during the crop cycle of 2021. The length of specimen was measured from the tip of rostrum to the end tip of uropod with the help of digital vernier calliper at the accuracy of ±0.02 mm and weight were taken by using an electronic balance to the nearest 0.01 gm (Lester, 1983) [13]. These length data of shrimp were divided in different length groups at the distances of 2.00 cm e.g. 10.001-12.000 cm, 12.001-14.000 cm and 14.001-16.000 cm which were designated as A, B and C respectively.

The length-weight relationship was calculated from nonlinear power function Y = aX^b (Ricker, 1973) [19] and from transformed data using linear equation Log (W) = log (a) + b log (L) prescribed by Pauly (1983) [16]. The condition factor (K) was determined from the equation K = (W/L^3) × 100 (Htun-Han, 1978) [20], where K is condition factor, W is weight (gm), L is total length (cm).

Result and Discussion
The data of morphometric variables were compiled and findings were depicted that length and weight of studied shrimp were noted 11.488-15.581 (13.393±0.035) cm and 12.26 to 31.22 (19.613±0.162) gm respectively (Table 1). The length frequency distribution data shows that length group B was dominated 377 (75%) among the studied shrimp population followed by length group C 100 (20%) and A containing 23 and 5% (Table 1). The assumptions of Fatima, (2000) [2] for penaeid shrimps (Tandel, 2020) [25] for whiteleg shrimp is substantiate the present results, while dominancy of large sized shrimp was reported by Fatima (2001) [3]; Solanki et al. (2020) [23] and Prajapati and Ujjania (2021) [18]. The length-weight relationship consents for the modification of growth-in-length to growth-in-weight in ordinary valuation representations (Silva et al., 2015) [21]. The variables (length and weight) are positive linearly related and correlation coefficient (r^2) was noted 0.633, 0.780, 0.809 and 0.906 for length group A, B, C and pooled population (Table 2, Fig. 1). The growth constant or regression coefficient (b) was found 2.541, 2.812, 3.531 and 2.997 for length group A, B, C and pooled population (Table 2). These findings elucidated that growth of studied shrimp was isometric (b=3.0) and indicate that the growth of shrimp was normal consequently length and weight were follow the cube law of the growth. The similar findings were reported by Konan et al. (2014) [19], Udoinyang et al. (2016) [26] and Khademzadeh and Hanghi (2017) [17] while Mane et al. (2019) [14] and Prajapati and Ujjania (2021) [18] reported positive allometric growth in the shrimp.

The condition factor imitates, through the situation variations, information on the physiological condition of fish in relation to the well-being (Prajapati and Ujjania, 2021) [18]. In existing study, it was observed for length group A 0.763-0.850 (0.814±0.005), for length group B 0.720-0.974 (0.806±0.002) and for length group C 0.729-0.910 (0.815±0.004) whereas it was 0.720-0.974 (0.808±0.002) for pooled population (Table 2). The resulted value of K was 1.0-0.5 which specified that the condition of studied shrimp inhabitant was variably good and aquatic environment of PEL pond conducive. Comparable findings for K value were reported by Kunda et al. (2008) [18] in P. penicillatus, Tandel (2020) [25] in L. vannameti and Solanki et al. (2020) [22] in P. monodon. In contradiction of existing findings more than 1.0 K value in L. vannameti was reported by Prajapati and Ujjania (2021) [18] from Gujarat and in P. monodon from Odisha and Maharashtra by Mohanty et al. (2015) [15] and Mane et al. (2019) [14] respectively.

Table 1: Length and weight observation in studied ponds.

<table>
<thead>
<tr>
<th>Length group</th>
<th>n</th>
<th>Total Length (cm)</th>
<th>Weight (gm)</th>
<th>Condition factor (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min-Max (Mean±SE)</td>
<td>Min-Max (Mean±SE)</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>23</td>
<td>11.488-11.993</td>
<td>12.26-14.66</td>
<td>0.763-0.850</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.815±0.039</td>
<td>13.437±0.141</td>
<td>0.814±0.005</td>
</tr>
<tr>
<td>B</td>
<td>377</td>
<td>12.003-13.998</td>
<td>14.06-25.62</td>
<td>0.720-0.974</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13.206±0.026</td>
<td>18.626±0.115</td>
<td>0.806±0.002</td>
</tr>
<tr>
<td>C</td>
<td>100</td>
<td>14.003-15.581</td>
<td>20.35-31.22</td>
<td>0.729-0.910</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14.462±0.042</td>
<td>24.753±0.285</td>
<td>0.815±0.004</td>
</tr>
<tr>
<td>Pooled</td>
<td>500</td>
<td>11.488-15.581</td>
<td>12.26-31.22</td>
<td>0.720-0.974</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13.393±0.035</td>
<td>19.613±0.162</td>
<td>0.808±0.002</td>
</tr>
</tbody>
</table>

Note: Length group A is 10.001-12.000 cm, B is 12.001-14.000 cm and C is 14.001-16.000 cm

Table 2: Statistical values of the variables in studied ponds.

<table>
<thead>
<tr>
<th>Length group</th>
<th>n</th>
<th>a</th>
<th>B</th>
<th>r^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>23</td>
<td>-1.598</td>
<td>2.541</td>
<td>0.633</td>
</tr>
<tr>
<td>B</td>
<td>377</td>
<td>-1.884</td>
<td>2.812</td>
<td>0.780</td>
</tr>
<tr>
<td>C</td>
<td>100</td>
<td>-2.705</td>
<td>3.531</td>
<td>0.809</td>
</tr>
<tr>
<td>Pooled</td>
<td>500</td>
<td>-2.090</td>
<td>2.997</td>
<td>0.906</td>
</tr>
</tbody>
</table>

Note: Length group A is 10.001-12.000 cm, B is 12.001-14.000 cm and C is 14.001-16.000 cm
Fig 1: Length - weight relationship of different length groups (A, B & C) and pooled population of *L. Vannamei* cultured in polyethylene line pond.

**Conclusion**
On the basis of these findings it can conclude that the growth of shrimp was isometric and normal. Compatibly, the value of condition factor was noted between < 1.0 and > 0.5 which specify that condition of the shrimp was fair good. Although cultured ponds environment was conductive for the shrimp but for optimal and commercial growth performances should be essential to alter the farm operations.

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13. Lizama M, DeLos AP, Ambrósio AM. Condition factor


