Cocoon Characteristics of *Antheraea pernyi* Silkworm Reared in Korean Oak Field

Bong-Seob Shin, Jong-Young Jeon, and Jong-Ho Kim*

School of Textile Engineering and Fashion Design, Kyungpook National University, Sangju, 742-711, Korea

(Received 6 November 2012; Accepted 27 December 2012)

*Antheraea pernyi* silkworm is a well known wild silkworm to produce a valuable silk fiber. *A. pernyi* silkworm was reared in Korean oak field and examined the cocoon characteristics, such as cocoon weight, cocoon shell weight, and percentage of cocoon shell weight. Degumming loss was also measured after alkali degumming process. *A. pernyi* silkworm spins tawny color cocoon in oval shape. Cocoon shell weight of *A. pernyi* silkworm, 0.78 g, was heavier than that of *B. mori* silkworm, 0.51 to 0.63 g. Cocoon shell percentage of *A. pernyi* silkworm, 32.8%, was higher than that of *B. mori* silkworm, 23.4 to 25.2%. Degumming loss percentage of *A. pernyi* silkworm, 17.1%, was lower than that of *B. mori* silkworm, 25.0%. SEM showed that the surface of the cocoon filament was coarse and oriented with longitudinal direction.

**Key words:** *Antheraea pernyi*, Cocoon trait, Cocoon shape, Degumming loss

**Introduction**

Cocoon has been used as a source of textile fiber in the world. It is spun by various kinds of silkworm; domestic silkworm, *Bombyx mori*, and wild silkworm, *Antheraea species*. Among them, *Antheraea pernyi* silkworm is one of the most useful insect to produce valuable textile fiber. In general, *A. pernyi* silkworm spun tawny color cocoon. The tawny color of *pernyi* cocoon is due to the cross-linked polymer of gentisic acid and silk protein (Tao et al., 1993). In Korea, *A. pernyi* silkworm has been reared until 1964 (Moon, 2000). Silk protein spun by *A. pernyi* is more stable against chemicals than that spun by *B. mori* silkworm (Kweon et al., 1998). Now a day, *A. pernyi* silk fibroin had been studied as a non-textile resource in various fields. Dissolution method of *A. pernyi* silk fibroin using various salts and characterized regenerated silk fibroin were reported by Kweon’s research group (Kweon et al., 2002; Kweon et al., 2003; Woo et al., 2000). Various types of architecture from *pernyi* fibroin has been reported such as nanofibers, scaffold, powder, and gel (He et al., 2011; Zhao et al., 2011; Lee et al., 2011; Yan et al., 2010). Lee et al., (2011) reported that hydrolyzed *A. pernyi* silk fibroin was separated into two parts: alanine-rich fraction and tyrosine-rich fraction. Wild silk fibroin hydrolysate enhances lipid metabolism and antioxidant defense (Um et al., 2011).

Though *pernyi* silk fibroin has been studied as non-textile materials such as food ingredient and biomaterials, the cocoon characteristics of *A. pernyi* silkworm cocoon has not been reported. Therefore, the authors examined cocoon characteristics of *A. pernyi* silkworm as a basic study for *A. pernyi* silk fibroin.

**Materials and Methods**

**Materials**

Wild silkworm cocoon, *A. pernyi* silkworm cocoon was harvested from oak field, National Academy of Agricultural Science, Suwon, Korea. The number of harvested one is 189 in 2009. Sodium carbonate and other chemicals were purchased and used without further purification.

**Examination of *A. pernyi* silkworm cocoon**

Each cocoon was weighed to calculate whole cocoon weight, cocoon shell weight, and percentage of cocoon shell weight. Thickness of the cocoon shell was measured...
with vernier calipers. The surface morphology of cocoon filament was observed using Field-Emission Scanning Electron Microscope (SUPRA 55VP, Carl Zeiss, Germany) after platinum coating.

**Degumming**
Wild cocoon was sliced and degummed as following method. One hundred fifty grams of cocoon was soaked into the degumming solution (sodium carbonate 2.5 g/L) at boiling temperature for 30 minutes and then washed with distilled water. The degumming process was repeated three times. Degumming loss percentage was calculated according to the following equation.

\[
\text{Degumming loss percentage (\%) = } \frac{(W_i - W_f)}{W_i} \times 100
\]

Where, \(W_i\) is initial weight of dry cocoon; \(W_f\), final weight of dry cocoon.

**Results and Discussion**

*Antheraea pernyi* silkworm cocoon

Oak silkworm is distributed on the far-east area including Korea, Japan, and northeastern China. There are two kinds of silkworms, *A. pernyi* and *A. yamamai*. Silkworm *A. yamamai* spins bright green color cocoon and fiber. However, *A. pernyi* silkworm makes a cocoon yellowish color shown in Fig. 1. The silkworms are fed on plantations of specially trimmed oak trees in National Academy of Agricultural Science. *A. pernyi* cocoon was harvested in 2009 and stored in conditioned room with low humidity and temperature.

The cocoons are oval in shape. The surface of cocoon is printed by oak leaf. After taking out the pupa, the thickness of the cocoon shell was measured. The thickness of the *A. pernyi* silkworm cocoon shell was 0.409±0.101 mm. On the other hand, that of *B. mori* silkworm cocoon was 0.517±0.077 mm. The thickness of the cocoon shell of *A. pernyi* silkworm was thinner than that of the authorized *B. mori* silkworm, YangWonJam.

The most important traits economically for silk production are single cocoon weight, cocoon shell weight, and cocoon shell percentage. Table 1 showed the cocoon traits of *A. pernyi* cocoon compared with *B. mori* cocoons. The average weight of *A. pernyi* cocoon completely dried is 2.36 g. To compare the cocoon traits, *Bombyx mori* silkworm variety, YangWonJam cocoon was harvested from Korean Farmer in 2012 and weighed cocoon characteristics. The reported average dry weights of authorized *Bombyx mori* cocoon for reeling test were 2.43 – 2.72 g. The dry weight of our result is similar to those of authorized them. The average weight of *A. pernyi* cocoon shell is 0.78 g. On the other hand, *B. mori* cocoons showed 0.51

**Table 1. Cocoon traits of Antheraea pernyi silkworm cocoon**

<table>
<thead>
<tr>
<th>Kinds of cocoon</th>
<th>Single cocoon weight (g)</th>
<th>Cocoon shell weight (g)</th>
<th>Cocoon shell percentage (%)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antheraea pernyi</td>
<td>2.36</td>
<td>0.78</td>
<td>32.8</td>
<td>This study</td>
</tr>
<tr>
<td>YangWonJam</td>
<td>-</td>
<td>0.51</td>
<td>23.4</td>
<td>This study</td>
</tr>
<tr>
<td>DaePoongJam</td>
<td>2.54</td>
<td>0.59</td>
<td>23.6</td>
<td>Kang <em>et al.</em>, (2012a)</td>
</tr>
<tr>
<td>DaeBakJam</td>
<td>2.72</td>
<td>0.63</td>
<td>23.2</td>
<td>Kang <em>et al.</em>, (2012a)</td>
</tr>
<tr>
<td>SooOkJam</td>
<td>2.55</td>
<td>0.60</td>
<td>23.7</td>
<td>Kang <em>et al.</em>, (2012b)</td>
</tr>
<tr>
<td>HanSaengJam</td>
<td>2.43</td>
<td>0.61</td>
<td>25.2</td>
<td>Kang <em>et al.</em>, (2011)</td>
</tr>
</tbody>
</table>