CHAPTER 8

Cocoon Commercial Characters
INTRODUCTION

The cocoon is the raw material used for reeling raw silk. It is in fact, a protective shell made up of a continuous and long proteinaceous silk filament made up of sericin and fibroin secreted from the silk glands of the mature silkworm prior to pupation for self-protection from adverse climatic factors and natural enemies. Economics of silk reeling industry and the quality of reeled product depend largely on the quality of cocoons used for reeling.

Size of the cocoon generally indicates the quantity of silk filament and percentage of silk in the cocoon and also the nature of the bave. Size of the cocoon, is generally indicated by the number of cocoons per litre and the number may vary from 110 to 150 with UV/BV cocoon and more with the multivoltine cocoons. The extent of tightness or firmness indicates the shell texture and compactness of the cocoon. The air and water permeability of cocoons in boiling is largely dependent on the hardness of the cocoon shell. The deflossed cocoon has a granular surface wrinkled with convolutions. The sparseness/closeness of the convolutions indicates the degree of
granulation. The outer layers of the cocoon have the coarser granules than in the inner layers. The important commercial character of cocoons is "weight". It indicates the approximate quantity of raw silk that can be reeled from it. The quantity of cocoons used to produce one unit of raw silk is called "Renditta", probably derived from rendition. The weight depends on the race, which may range from 1 gram to 3 grams. Shell weight is another important as it is the shell that yields silk for reeling, largest shell weight may range from 300 mg as in pure races to 350 to 500 mg as in hybrids. Indian multivoltine hybrids weighs hardly 150 mg, and it is still less in multivoltine pure races. The ratio between the weight of silk shell and the whole weight or the cocoon calculated as a percentage gives us the shell ratio. The Indian multivoltine hybrids contain shell ratio from 12 to 15 per cent while newly evolved hybrids 16-19.1% and the multivoltine pure varieties contain from 10-12% and the Japanese reeling cocoons contain as high as 19-25%. The filament length of a cocoon varies according to the breed. The multivoltines can yield above 500 mts. of silk filament and 700-1000 mts. or filament can be unwound from the cocoons of bivoltine races.

Cocoon crop quality and quantity is generally depended on the vigour of silkworm breeds and also is influenced by the mulberry leaf quality (Venugopala Pillai et al., 1987). According to Bajpeyi et al., (1991), the raw silk production per hectare of land is approximately 52 kgs in China and 40 kgs. in Japan. Whereas in India, it is only 31
It can be said that the low productivity in India, is due to poor quality of leaf. There were many studies to improve quality and quantity of cocoons by supplementing with nutrients such as sugars, proteins, lipids, vitamins etc. (Nagarajan and Radha, 1990; Masilamani et al., 1991; Bajpeyi et al., 1991). However, a few studies were reported (Nagarajan and Radha, 1990; Masilamani et al., 1991; Radhakrishnaiah and Chamundeswari, 1994; Sailaja et al., 1997). Narasimha Murthy and Govindappa, (1988), demonstrated that supplementation of cobalt improved the larval weights shell weight and ERR. Bajpeyi et al., 1991, added calcium, magnesium and iron to mulberry leaves and observed significant enhancement of rearing rate and silk content in the cocoon. Radhakrishnaiah and Chamundeswari, (1994) found that zinc and nickel are acting as supplements to stimulate the protein synthesis. There are reports available on the dietary administration of several vertebrate hormones and prostaglandins enhancing both developmental and metabolic processes of silkworm Bombyx mori L. (Bharathi, 1993; Bharathi, 1995; Chaudhury and Medda, 1986 and 1992; Bharathi, 1993 and 1995; Megadum and Hooli, 1988 and Magadum and Magadum, 1993.)

Many reviews on the dietary effect of selenium in animals revealed that the selenium supplementation stimulated the growth in animals. Selenium, although required in only of small amounts in animals, has an essential metabolic role as part of the enzyme glutathione peroxidase that protects cell membranes against oxidative
damage (Hoekstra, 1975). Severe deficiency of selenium in the diets of sheep was reported which was characterized by clinical symptoms of white muscle disease and mortality in lambs. Supplementation with selenium increase wool production, body weight gain and reproductive rate was reported in sheep (Wilkins et al., 1982, Langlands et al., 1991, Langlands et al., 1994; Whelan et al., 1994). Deka et al. (1999) described the role played by selenium in the improvement of silk protein function, which resulted in increased cocoon commercial parameters of Eri silkworm, Philosamia Cynthia L.

In the present study an attempt was made to study the impact of selenium on exposure to lethal (32.39 µg/kg body wt.) and sub lethal doses (6.47 µg/kg body wt.) of selenium on cocoon commercial characters of silkworm Bombyx mori L.

RESULTS

From the data presented in the table 46 and Figure 46a, it is seen that the cocoon commercial characters such as single cocoon length, cocoon width, cocoon weight, shell weight, shell percentage, filament weight and filament length registered a significant decrease (P<0.05) when compared to controls (groups 1, 4, 7 and 10) in all silkworms (group 2, 5, 8 and 11) on exposure to lethal dose of selenium. The percent decrease at lethal dose was progressed towards 6 day and was in the order 3<4<5<6 days.
In sub lethal dose all the cocoon characters registered an elevation in all groups of V instar silkworms (group 3, 6, 9 and 12) exposed at 3, 4, 5, and 6 days. Based on percent values, this increase was high at 6 day exposure period and followed the trend 3<4<5<6.

**DISCUSSION**

Cocoon characteristic features determine the quality, quantity and cocoon commercial value of the silk. The quality of the cocoon, mainly depend on the healthy larval growth which in turn reflects on the quality and quantity of mulberry leaves, fed during silkworm rearing besides adopting advanced rearing technology. In the present investigation the cocoon commercial characters such cocoon length, cocoon width, cocoon weight, shell ratio, filament weight, and filament length of silkworm cocoon are significantly decreased when exposed to lethal dose of selenium when compared to controls. Venkat Reddy et al. (1991) reported that the lethal and sub-lethal doses of fenvelrate might have exerted its effect on the silk gland of the silkworm. As a result the protein synthesis might have hindered and reduced the spinning activity and ultimately resulted in poor silk emission. Metabolism of selenium on silkworm is still not fully understood and also not clear whether selenium acts as protein inhibitor/inducer. However in vertebrates many reports (Wilkins et al., 1982; Langlands et al., 1991 and 1994; Whelan et al., 1994) suggest that supplementation with selenium can increase wool production, body weight gain and reproductive rate. (Langlands et al, 1991) reported
that concentration of selenium in plasma 0.06 and 0.024 were associated with deficiencies in reproducing ewes and supplementation resulted in increased wool growth and fiber diameter.

Compared to controls, all the cocoon characters, such as cocoon length, cocoon weight, filament length, filament weight, shell ratio, etc. have registered a significant increase on exposure to sub lethal dose of selenium. It can be attributed that selenium in lower dose might be responsible for promotion of silk synthesis. The results indicate that selenium in minute quantities trigger the protein synthesis in the silkworm. The results were also inconformity with the significant growth of silkworm on exposure to sub lethal dose of selenium. It is known that selenium deficiency produce marked decrease in growth and greatly interfere with efficiency of food utilization by animals. In the present study, supplementation of selenium in sub-lethal dose to silkworm might have shown impact on the efficiency of feed utilization and growth. Thereby the increased energy status could be utilized for protein synthesis. From the above discussion, it can be concluded that the toxicity of selenium on silkworm cocoon commercial characters is having adverse impact on administration of lethal dose.

However, in the silkworm exposed to sub lethal dose of selenium the cocoon commercial characters were improved. Thus selenium influenced the bio-chemical, physiological pathways to improve the
cocoon commercial characters. It can be assumed that the harmful microbial flora of silkworm might have been eliminated in the sublethal doses of selenium without affecting the silkworms, which ultimately improved the general health of the silkworm leading to betterment of cocoon commercial characters.
<table>
<thead>
<tr>
<th>Days exposure</th>
<th>Dosage</th>
<th>Cocoon length (mm)</th>
<th>Cocoon width (mm)</th>
<th>Cocoon weight (gm.)</th>
<th>Shell weight (gm.)</th>
<th>Shell Percentage %</th>
<th>Filament length (mt.)</th>
<th>Filament weight (mg.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 days</td>
<td>Control</td>
<td>31.82 b</td>
<td>17.56 b</td>
<td>1.44 b</td>
<td>0.25 b</td>
<td>15.2 b</td>
<td>541.04 b</td>
<td>218.19 b</td>
</tr>
<tr>
<td></td>
<td>Lethal</td>
<td>30.4 a (-4.46)</td>
<td>15.81 a (-9.96)</td>
<td>1.16 a (-19.4)</td>
<td>0.178 a (-28.0)</td>
<td>11.56 a (-23.9)</td>
<td>367.91 a (-31.9)</td>
<td>199.19 a (-8.7)</td>
</tr>
<tr>
<td></td>
<td>Sublethal</td>
<td>37.22 c (+16.9)</td>
<td>21.34 c (+21.5)</td>
<td>1.85 c (+20.47)</td>
<td>0.35 c (+40.0)</td>
<td>18.5 c (+21.7)</td>
<td>765.54 c (+41.0)</td>
<td>250.89 c (+14.9)</td>
</tr>
<tr>
<td>4 days</td>
<td>Control</td>
<td>32.99 b</td>
<td>18.23 b</td>
<td>1.48 b</td>
<td>0.268 b</td>
<td>15.72 b</td>
<td>580.2 b</td>
<td>230.2 b</td>
</tr>
<tr>
<td></td>
<td>Lethal</td>
<td>21.12 a (-35.9)</td>
<td>12.26 a (-33.1)</td>
<td>0.96 a (-35.1)</td>
<td>0.14 a (-47.0)</td>
<td>10.20 a (-35.0)</td>
<td>240.86 a (-58.0)</td>
<td>160.00 a (-30.4)</td>
</tr>
<tr>
<td></td>
<td>Sublethal</td>
<td>38.77 c (+17.5)</td>
<td>22.46 c (+23.2)</td>
<td>1.88 c (+27.02)</td>
<td>0.4 c (+49.2)</td>
<td>19.19 c (+22.07)</td>
<td>823.06 c (+42.0)</td>
<td>270.62 c (+17.5)</td>
</tr>
<tr>
<td>5 days</td>
<td>Control</td>
<td>33.86 b</td>
<td>19.01 b</td>
<td>1.52 b</td>
<td>0.301 b</td>
<td>16.3 b</td>
<td>628.29 b</td>
<td>232.45 b</td>
</tr>
<tr>
<td></td>
<td>Lethal</td>
<td>15.42 a (-54.4)</td>
<td>10.89 a (-47.37)</td>
<td>0.85 a (-44.07)</td>
<td>0.11 a (-63.4)</td>
<td>8.40 a (-48.4)</td>
<td>220.15 a (-64.0)</td>
<td>150.29 a (-35.0)</td>
</tr>
<tr>
<td></td>
<td>Sublethal</td>
<td>39.96 c (+18.0)</td>
<td>23.51 c (+23.7)</td>
<td>1.95 c (+28.2)</td>
<td>0.451 c (+49.9)</td>
<td>20.0 c (+22.7)</td>
<td>898.20 c (+43.9)</td>
<td>274.8 c (+18.2)</td>
</tr>
<tr>
<td>6 days</td>
<td>Control</td>
<td>34.40 b</td>
<td>19.8 b</td>
<td>1.56 b</td>
<td>0.34 b</td>
<td>17.8 b</td>
<td>775.4 b</td>
<td>245.09 b</td>
</tr>
<tr>
<td></td>
<td>Lethal</td>
<td>12.80 a (-67.9)</td>
<td>9.4 a (-52.5)</td>
<td>0.61 a (-60.8)</td>
<td>0.101 a (-70.0)</td>
<td>6.25 a (-64.0)</td>
<td>214.78 a (-72.0)</td>
<td>100.47 a (-59.0)</td>
</tr>
<tr>
<td></td>
<td>Sublethal</td>
<td>40.84 c (+18.7)</td>
<td>24.75 c (+25.0)</td>
<td>2.01 c (+28.9)</td>
<td>0.53 c (+55.8)</td>
<td>22.00 c (+23.5)</td>
<td>1110.2 c (+43.0)</td>
<td>292.3 c (+19.3)</td>
</tr>
</tbody>
</table>

* Each value is a mean of eight estimates
** Percent decrease over control is given in parenthesis
*** Means with in a column followed by the same letter are not significantly different (p > 0.05) from each other according to Duncan’s multiple range tests.
Fig. 46 Percent change over control in Cocoon Commercial Characters of V instar *Bombyx mori* L. exposed to lethal and sub-lethal dose of Selenium.
Plate IX

a, b & c: Cocoons of V instar Silkworm *Bombyx mori* L. (PM X NB₄D₂) exposed to lethal and sub lethal doses of selenium at 3 day

a : Group 1 (Control)
b : Group 2 (Lethal)
c : Group 3 (Sub lethal)
Plate X

a, b & c: Cocoons of V instar Silkworm *Bombyx mori* L. (PM X NB₄D₂) exposed to lethal and sub lethal doses of selenium at 3 and 4 day.

a : Group 4 (Control)
b : Group 5 (Lethal)
c : Group 6 (Sub lethal)
Plate XI

a, b & c: Cocoons of V instar Silkworm *Bombyx mori* L. 
(PM X NB₄D₂) exposed to lethal and sub lethal 
doses selenium at 3,4 and 5 day.

a : Group 7 (Control)
b : Group 8 (Lethal)
c : Group 9 (Sub lethal)
Plate XII

a, b & c: Cocoons of V instar Silkworm *Bombyx mori* L. (PM X NB₄D₂) exposed to lethal and sub lethal doses of selenium at 3, 4, 5 and 6 day.

a : Group 10 (Control)
b : Group 11 (Lethal)
c : Group 12 (Sub lethal)