INSECTICIDAL ACTIVITIES OF ABROMA AUGUSTA (L.) CHLOROFORM AND METHANOL EXTRACTS AGAINST TRIBOLIUM CASTANEUM (HERBST) ADULTS

Omar Ali Mondal¹, Esarul Haque², Jahurul Haque³ and Ataur Rahman Khan¹∗

¹Department of Zoology, University of Rajshahi, Rajshahi-6205, Bangladesh,
²Department of Zoology, Premtali Degree College, Godagari, Rajshahi, Bangladesh

Abstract: The chloroform and methanol extracts of the leaves, root wood, stem bark, stem wood and seeds of Abroma augusta (L.) (Ulatkambal) were tested against Tribolium castaneum (Herbst) adults through residual film assay. The seed extracts (CHCl₃ and MeOH) were found to offer the highest mortality of the beetles and the LD₅₀ values were 3046.083, 247.9217 and 75.96001 µg/cm² and 6598.793, 340.4855 and 113.6461 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposures respectively. The root wood extracts gave LD₅₀ values of 1127.785, 312.5822 and 146.3708 µg/cm² and 1689.468, 449.8259 and 134.9692 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposures respectively. These were followed by the leaf (CHCl₃ and MeOH) extracts that gave LD₅₀ values of 1346.807, 450.3049 and 175.7438 µg/cm² and 4654.238, 1010.538 and 1127.785 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposure respectively. The stem wood extracts (CHCl₃ and MeOH) gave LD₅₀ values of 3295.859, 1137.558 and 363.1539 µg/cm² and 3717.851, 566.2215 and 230.7044 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposure respectively. The stem bark extracts (CHCl₃ and MeOH) gave LD₅₀ values of 3295.859, 1137.558 and 363.1539 µg/cm² and 3717.851, 566.2215 and 230.7044 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposure respectively. The stem bark extracts (CHCl₃ and MeOH) gave LD₅₀ values of 3295.859, 1137.558 and 363.1539 µg/cm² and 3717.851, 566.2215 and 230.7044 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposure respectively. The root wood extracts gave LD₅₀ values of 4654.238, 1010.538 and 175.7438 µg/cm² and 1689.468, 449.8259 and 134.9692 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposure respectively. The leaf (CHCl₃ and MeOH) extracts gave LD₅₀ values of 1346.807, 450.3049 and 175.7438 µg/cm² and 4654.238, 1010.538 and 1127.785 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposure respectively. The seed extracts (CHCl₃ and MeOH) were found to offer the highest mortality of the beetles and the LD₅₀ values were 3046.083, 247.9217 and 75.96001 µg/cm² and 6598.793, 340.4855 and 113.6461 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposures respectively. The root wood extracts gave LD₅₀ values of 1127.785, 312.5822 and 146.3708 µg/cm² and 1689.468, 449.8259 and 134.9692 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposures respectively. These were followed by the leaf (CHCl₃ and MeOH) extracts that gave LD₅₀ values of 1346.807, 450.3049 and 175.7438 µg/cm² and 4654.238, 1010.538 and 1127.785 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposure respectively. The stem wood extracts (CHCl₃ and MeOH) gave LD₅₀ values of 3295.859, 1137.558 and 363.1539 µg/cm² and 3717.851, 566.2215 and 230.7044 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposure respectively. The stem bark extracts (CHCl₃ and MeOH) gave LD₅₀ values of 3295.859, 1137.558 and 363.1539 µg/cm² and 3717.851, 566.2215 and 230.7044 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposure respectively. The root wood extracts gave LD₅₀ values of 4654.238, 1010.538 and 175.7438 µg/cm² and 1689.468, 449.8259 and 134.9692 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposure respectively. The leaf (CHCl₃ and MeOH) extracts gave LD₅₀ values of 1346.807, 450.3049 and 175.7438 µg/cm² and 4654.238, 1010.538 and 1127.785 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposure respectively.

Key words: Abroma augusta, Insecticidal activity, Chloroform and methanol extracts, Tribolium castaneum.

Introduction

Botanical pesticides, as an alternative to the conventional chemical agents for insect control are now-a-days very popular among the pest control experts. They are more readily biodegradable and therefore, are less likely to contaminate the environment. Moreover, natural compounds break down readily in soil and are not stored in plant or animal tissues. The use of phytochemicals as powder, oil and extracts for the control of stored-product insect pests has much agricultural importance and recently has received much more attention because these insecticidal compounds are safer than synthetic pesticides, cheaper and can easily be obtained from plants with less sophisticated methods.

Abroma augusta L. (Sterculiaceae), commonly known as ulatkambal, is a large spreading bushy shrub with fibrous barks and irritant hairs. The branches and branchlets are downy. When freshly cut the root produces a thick gummy substance. The root bark is tasteless, slimy, odorless and tough. When soaked in cold water for 3-4 days, the bark produces slimy mucilage which can be extracted (Anonymous 2006, Nandkarni 2002).

Being a medicinal plant, A. augusta contains antipathogenic properties and almost all the parts of the plant are used in the treatment of different diseases. Insecticidal activities of the plant have been demonstrated by a number of recent workers viz., Prajapati et al. (2003), Nanda (1997), Halim (2003), Hanif et al. (2010), Kirtikar and Basu (1918, 1999), Nandkarni (2002), Rahamtullah et al. (2010).

The rust-red flour beetle, Tribolium castaneum (Herbst) is a major pest of a wide range of stored commodities. The insecticidal activities of A. augusta extracts have been attempted and the investigation has been designed to evaluate the efficacy of the plant parts as a possible source of potential secondary metabolites to be used as environment-friendly pest control agents against T. castaneum.
Materials and Methods

Preparation of plant materials for extraction: The experimental plant (*A. augusta*) was collected from the campus of the University of Rajshahi, Bangladesh. After drying under shade the plant materials, viz. leaves, root wood, seeds, stem bark and stem-wood were powdered in a grinder separately.

Chemical extraction from the plant materials: Chloroform and methanol were selected as solvents to extract different parts of *A. augusta* separately. The ground dried materials were extracted with sufficient amounts of chloroform (500g × 1500ml × 3 times) for each of the items. Separate extracts were collected by the cool method after 72 hours of plunging for each of the materials. Extracts, thus obtained, were subjected to filtration and evaporation of the solvents. The residue were left and kept in a refrigerator after proper labeling.

Application of doses:

Through an *ad hoc* experiment a general concentration for the extracts was selected as 10 mg/2ml as the stock solution for surface film application to make other successive doses by serial dilution to give 1040, 780, 520, 260, 130 and 65 µg/cm² concentrations. The application of the doses was made by the residual film method (Busvine, 1971). For each dose 1ml of the extract was dropped on a Petri dish (70 mm diam.) in such a way that it made a uniform film over the Petri dish. Then the Petri dishes were air-dried and 10 beetles (3-5-day old) were released in each of the Petri dishes with three replicates. A control batch was also maintained with the same number of insects after preparing the Petri dish by applying and evaporating the solvent only. Mortality data were recorded for 30min, 24h and 48h postexposure.

Statistical Analyses

The mortality of the beetles was corrected by the Abbott’s (1925) formula:

\[ P_\text{r} = \frac{P_o - P_c}{100} \]

Where, \( P_r \) = Corrected mortality (%);
\( P_o \) = Observed mortality (%) and \( P_c \) = Control mortality (%).

Data were subjected to statistical analyses according to Finney (1947) and Busvine (1971). The experiment was conducted at a room temperature of 30 ± 2°C.

Results and Discussion

The results have been presented in Tables 1 and 2 for the mortality recorded and have been shown in Fig.1 and 2. The seed extracts were found to offer the highest mortality of the beetles for both the solvents. According to the degree of activity observed through mortality of the adult beetles the potentiality of the chloroform extracts could be arranged in a descending order of seed> root wood > leaf> stem bark extracts and of the methanol extracts, seed>root wood > stem bark > leaf extracts.

Table 1 Dose-mortality effects of *A. augusta* extracts (CHCl₃) against *T. castaneum* adults.

<table>
<thead>
<tr>
<th>Test part</th>
<th>Exposure period</th>
<th>LD₅₀ value (µg/cm²)</th>
<th>95% Conf. limits</th>
<th>Regression equation</th>
<th>( \chi^2 )-Value (df)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaf</td>
<td>30 min.</td>
<td>3466.807</td>
<td>2835.810</td>
<td>Y = -2.112 - 0.816X</td>
<td>0.199(3)</td>
</tr>
<tr>
<td></td>
<td>24 h</td>
<td>450.305</td>
<td>280.002</td>
<td>Y = -1.863 - 1.183X</td>
<td>1.549 (3)</td>
</tr>
<tr>
<td></td>
<td>48 h</td>
<td>175.744</td>
<td>129.368</td>
<td>Y = 1.099 + 1.738X</td>
<td>5.069(3)</td>
</tr>
<tr>
<td>Root wood</td>
<td>30 min.</td>
<td>1127.787</td>
<td>723.641</td>
<td>Y = 1.668 + 1.092X</td>
<td>0.447(3)</td>
</tr>
<tr>
<td></td>
<td>24 h</td>
<td>312.582</td>
<td>207.490</td>
<td>Y = 2.002 + 1.202X</td>
<td>0.124(3)</td>
</tr>
<tr>
<td>Stem bark</td>
<td>30 min.</td>
<td>329.855</td>
<td>889.985</td>
<td>Y = 0.197 + 1.365X</td>
<td>0.229(3)</td>
</tr>
<tr>
<td></td>
<td>24 h</td>
<td>1137.558</td>
<td>538.928</td>
<td>Y = 2.183 + 1.035X</td>
<td>0.529(3)</td>
</tr>
<tr>
<td>Seed</td>
<td>30 min.</td>
<td>3046.083</td>
<td>25010.390</td>
<td>Y = 2.258 + 0.787X</td>
<td>0.337(4)</td>
</tr>
<tr>
<td></td>
<td>24 h</td>
<td>247.922</td>
<td>131.750</td>
<td>Y = 2.395 + 0.879X</td>
<td>3.868(4)</td>
</tr>
</tbody>
</table>

Table 2 Dose-mortality effects of *A. augusta* extracts (CH₃OH) against *T. castaneum* adults.

<table>
<thead>
<tr>
<th>Test part</th>
<th>Exposure period</th>
<th>LD₅₀ value (µg/cm²)</th>
<th>95% Conf. limits</th>
<th>Regression equation</th>
<th>( \chi^2 )-Value (df)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaf</td>
<td>30 min.</td>
<td>4654.238</td>
<td>43590.610</td>
<td>Y = -1.481 + 0.959X</td>
<td>0.183(3)</td>
</tr>
<tr>
<td></td>
<td>24 h</td>
<td>1010.538</td>
<td>2714.704</td>
<td>Y = 2.293 + 0.901X</td>
<td>1.721(3)</td>
</tr>
<tr>
<td></td>
<td>48 h</td>
<td>333.720</td>
<td>544.177</td>
<td>Y = 2.434 + 1.017X</td>
<td>1.662(3)</td>
</tr>
<tr>
<td>Root wood</td>
<td>30 min.</td>
<td>1689.468</td>
<td>4825.927</td>
<td>Y = 2.057 + 1.221X</td>
<td>0.243(3)</td>
</tr>
<tr>
<td></td>
<td>24 h</td>
<td>449.826</td>
<td>578.641</td>
<td>Y = 2.288 + 1.022X</td>
<td>0.243(3)</td>
</tr>
<tr>
<td>Stem bark</td>
<td>30 min.</td>
<td>134.969</td>
<td>220.082</td>
<td>Y = 2.535 + 1.157X</td>
<td>3.755(3)</td>
</tr>
<tr>
<td></td>
<td>24 h</td>
<td>3717.851</td>
<td>19276.680</td>
<td>Y = 2.132 + 1.030X</td>
<td>0.779(3)</td>
</tr>
<tr>
<td>Seed</td>
<td>30 min.</td>
<td>566.222</td>
<td>894.166</td>
<td>Y = 2.193 + 1.092X</td>
<td>0.761(3)</td>
</tr>
<tr>
<td></td>
<td>48 h</td>
<td>30.704</td>
<td>339.295</td>
<td>Y = 2.258 + 0.597X</td>
<td>5.414(3)</td>
</tr>
<tr>
<td></td>
<td>24 h</td>
<td>6598.793</td>
<td>15375.800</td>
<td>Y = 2.450 + 0.668X</td>
<td>0.220(4)</td>
</tr>
<tr>
<td></td>
<td>48 h</td>
<td>113.646</td>
<td>166.772</td>
<td>Y = 2.588 + 1.188X</td>
<td>1.013(4)</td>
</tr>
</tbody>
</table>
Fig. 1 Probit mortality regression lines of the chloroform extracts of *A. augusta*: A- Seed/ 24 h; B- Seed/ 48 h; C- root wood/ 24 h; D- root wood/ 48 h; E- stem bark/ 24 h; F- stem bark/ 48 h; G- leaf/ 24 h and H- leaf/ 48 h of exposure against *T. castaneum* adults.
Fig. 2 Probit mortality regression lines of the methanol extracts of *A. augusta*: A- Seed/ 24 h; B- Seed/ 48 h; C- root wood/ 24 h; D- root wood/ 48 h; E- stem bark/ 24 h; F- stem bark/ 48 h; G- leaf/ 24 h and H- leaf/ 48 h of exposure against *T. castaneum* adults.
The seed extracts (of both the solvents) offered the highest mortality of *T. castaneum*. However, the comparatively higher doses of the root wood, stem bark and leaf extracts indicate weaker action. The test extracts produced mortality within 30 min of application just to prove their acute toxicity. The seed, root wood and stem bark extracts were found to possess bioactive potential(s) with comparatively higher insecticidal activity but the stem bark extract was comparatively mild in action followed by the leaf extract. The stem wood extract did not show any activity against *T. castaneum*. The present results support the previous work of Naqvi and Parveen (1991) who observed that the seed extract of *A. augusta* showed a remarkable insecticidal activity against *T. castaneum*.

The present results clearly demonstrate that both the chloroform and methanol extractives from various parts of *A. augusta* have significant insecticidal activities. These results are in agreement with similar works of Krishnamurti and Rao (1944), Su et al. (1972), Sangappa (1977) and Rao et al. (2010). Abdullah et al. (2011) assessed the mortality and repellency of the chloroform extracts of different parts of *Urena sinuata* on *T. castaneum* adults.

**Conclusion**

A perusal of the data reveal that *A. augusta* extracts can be used as insecticidal compounds in the grain and cereal stores to manage the population of *T. castaneum*. The results also seem to be encouraging when there is a greater need for environment-friendly pesticides than ever before. The overall assessment of toxicity of *A. augusta* extracts are very much promising and their efficacy on stored grain pests might have future to be used as a control agent or tool. It may open its possibility as a control agent for the insect pests as well. However, much more comprehensive investigation is needed in this area.

**Acknowledgement**

The authors remain grateful to the Chairman, Department of Zoology, University of Rajshahi, Bangladesh, for kindly supplying the required laboratory facilities.

**References**


**Manuscript received on 9 July 2013 and revised on 9 November 2013**