Insects Infestation and Preventive Measures in Dry Fish Storage of Chittagong, Bangladesh

Mohammed Ashraful Azam Khan and Yusuf Sharif Ahmed Khan
Institute of Marine Sciences, University of Chittagong, Bangladesh

Abstract: Six experiments were conducted to assess losses, magnitude of infestation and to develop preventive measures for 12 weeks to combat the beetles infestation on sun dried ribbon fish by treating with pirimphos-methyl at a concentration dose of 0.12, 0.06 and 0.03%, saturated brine solution and dried 'Bishkatali' (Polygonum hydropiper) plants. For comparative studies a batch of ribbon fish was also stored without any treatment as a control. The treatment of 0.12 and 0.06% pirimphos-methyl showed excellent result against beetles infestation during storage, while the control suffered from effective weight loss of about -25.47% instead of increase due to rise of moisture content. The 0.12 and 0.06% pirimphos-methyl treated fish showed weight change of +2.94 and -0.66% respectively, which were economic to the traders.

Keywords: Insect, infestation, dry fish, storage, Bangladesh

Introduction
Most of the marine fishes, which are caught in remote coastal areas and islands viz. Aftabchar, Dubla, Kutubdia, Khushkhuli, Moheshkhali, Rabgali, Sonadia and St. Martins of Chittagong, Bangladesh are simply sun dried and only a small portion is cured. A substantial amount of these fishes are being damaged during processing. This damage mainly occurs due to pest infestation during the process of drying and storage and during transport to wholesale market and retail shop. It was reported that at least 30% of the fish meat was lost due to 'Maggot' infestation. During heavy infestation, the fishermen spray insecticides injudiciously which causes hazards to human health.

The cured / dried fishes are stored in damp warehouses and particularly during monsoon period when moisture content is high in the weather, the dry fishes absorb moisture so rapidly that the fish becomes favourable for infestation by beetles and mites. Besides, in most cases fishes are not dried properly resulting pest infestation.

Curers apply different types of insecticides namely dichlorvos (Trade name 'Nigos' 100 ec), malathion, gamaoxine, endrine, DDT etc. on dried fishes to protect the product from infestation disobeying the recommendation made by Codex Alimentarius or FAO / WHO Joint Meeting Pesticide Residue Committee (JMPRC).

The insect infestation that need to combat has long been recognized by the fish processors. A literature survey was conducted to find out the use of insecticides on fresh or cured fish or their products; earlier reviews having been undertaken by Blatchford (1962), Taylor and Proctor (1979), FAO (1981), Taylor and Evans (1982) and Walker (1987). Insect's infestation during drying, transportation, storage condition and even in marketing is very scanty. In this regard work of Ahmed et al. (1988), Ahmed et al. (1989), Bhuiyan and Huda (1981), Bhuiyan (1990) and Reza et al. (1983) on insect infestation is the end.

In Bangladesh dried fishes are important source of low cost dietary protein. At present total fish production is about 1.2 million tonnes, of which 15% of fishes are cured for mass people consumption at the scarcity of fresh fishes. For retailing the dry fish in rainy season it was found that 10-20% of the stored product lost due to insect infestation. This loss in insects infesters for the addition of unapproved insecticide that will cause health hazard in long run. In order to save the mass people from health hazard approved insecticide as well as some preventive measures have to introduce the research activities.

Materials and Methods
In order to determine the magnitude of beetles infestation and subsequent losses during storage were carried out in a well ventilated and clean store at Asagdon, Chittagong. The experiments were conducted for 12 weeks and each was treated with pirimphos-methyl at concentration dose of 0.12%, 0.06% and 0.03%, saturated brine solution and dried 'Bishkatali' plants. For comparative study a batch of fish was stored without any treatment as a control. Five experiments and a control were conducted with 25 dried ribbon fish having a wt. of 2.5 kg in each experiment collected from the local market of Chittagong.

In first three experiments fishes were dipped in 0.12, 0.06 and 0.03% amulsion of pirimphos-methyl in 10 litres of water each for 15 sec. and suspended to drain off excess water for 30 sec.

In fourth experiments fishes were dipped in the saturated brine solution, allowed for 3 hours just to penetrate salt especially in mouth and gill regions where blowfly generally lay their eggs.

In experiment No. 5 fishes were conducted dried 'Bishkatali' plants at a weight of the treated fish. In the last and 5th experiment fishes were dipped in coastal water that served as control. After dipping fishes were allowed for 1 min, to drain off excess water. Drying was made by keeping the fish inclined toward the sun for 1 hr. and then finally dried in shade before placed them in store / godown. After storing of 12 weeks, fishes were weighed for each trial and examined for the presence of larvae and adult, dead and alive, larval casts Dermestes and Necrobia spp. and individually they were counted. The extent of damage was assessed according to the following grading system:

Code: Observation
O No sign of damage.
L Occasional holes and canal cavity in flesh.
M Numerous holes and canals but flesh not completely eaten.
H Flesh completely eaten out remaining bones only.

The above regime was taken from the scheme devised and developed for use in Indonesia (Esser et al.,1986) and Thailand (Rattagool et al.,1988).

Results
The weight and moisture content of the dried fishes treated with 0.12% pirimphos-methyl were 2500 gm and 19.8% respectively. At the end of storage, the weight was found to
Table 1: Experiment on the effectiveness of the preservation after 12 weeks of infestation in sun dried ribbon fish (Trichinurus spp.) stored in sodown of Chittagong wholesale dry fish market

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Weight before storage (gm)</th>
<th>% of moisture content before storage</th>
<th>Weight after storage (gm)</th>
<th>% of moisture content after storage</th>
<th>% of weight change</th>
<th>% of effective weight loss (A) (sold)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primiphosmethy 0.12%</td>
<td>2650</td>
<td>19.8</td>
<td>2625</td>
<td>23.3</td>
<td>+2.94</td>
<td>-1.24</td>
</tr>
<tr>
<td>Primiphosmethy 0.06%</td>
<td>2610</td>
<td>20.0</td>
<td>2486</td>
<td>22.9</td>
<td>-0.96</td>
<td>-3.63</td>
</tr>
<tr>
<td>Primiphosmethy 0.03%</td>
<td>2530</td>
<td>18.8</td>
<td>2476</td>
<td>22.6</td>
<td>-2.29</td>
<td>-5.41</td>
</tr>
<tr>
<td>Saturated Brine</td>
<td>2610</td>
<td>20.0</td>
<td>2560</td>
<td>24.0</td>
<td>-1.29</td>
<td>-4.46</td>
</tr>
<tr>
<td>Died Bishkattali</td>
<td>2650</td>
<td>18.3</td>
<td>2480</td>
<td>21.8</td>
<td>-2.73</td>
<td>-5.83</td>
</tr>
<tr>
<td>Control</td>
<td>2600</td>
<td>18.2</td>
<td>1829</td>
<td>23.0</td>
<td>-26.84</td>
<td>-26.47</td>
</tr>
</tbody>
</table>

(A) Approach to the assessment of losses in Cured fish is given in Appendix

Table 2: Experiment of insects infestation and fish damage after 12 weeks in sun dried ribbon fish (Trichinurus spp.)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Weight before storage (gm)</th>
<th>Weight after storage (gm)</th>
<th>Number of larvae</th>
<th>% of fish with casts</th>
<th>% of damage fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primiphosmethy 0.12%</td>
<td>2650</td>
<td>2625</td>
<td>*10</td>
<td>16</td>
<td>O</td>
</tr>
<tr>
<td>Primiphosmethy 0.06%</td>
<td>2610</td>
<td>2486</td>
<td>*28</td>
<td>16</td>
<td>L</td>
</tr>
<tr>
<td>Primiphosmethy 0.03%</td>
<td>2630</td>
<td>2476</td>
<td>63</td>
<td>44</td>
<td>M</td>
</tr>
<tr>
<td>Saturated Brine</td>
<td>2610</td>
<td>2660</td>
<td>30</td>
<td>62</td>
<td>H</td>
</tr>
<tr>
<td>Died Bishkattali</td>
<td>2660</td>
<td>2490</td>
<td>90</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>2600</td>
<td>1829</td>
<td>19</td>
<td>92</td>
<td></td>
</tr>
</tbody>
</table>

* Included small larvae likely to have developed from eggs deposited on fish.

O-No damage                L-Light damage           M-Medium damage           H-High damage

Fig. 1: Fish damage in different treatment (P-M = Primiphos-methy, S-Brine = Saturated brine)

increase 75 gm, consequently the moisture of the fish also increase from 19.8 to 23.3%, which showed a weight change of +2.94% (Table 1). In this treatment two alive and four dead adult Darmestes spp. and one dead Necrobia rufipes was recorded. The stored fishes under this treatment were very excellent in colour, only 4% fishes with scanty casts (Table 2).

In 0.08% primiphos-methy treated dried fish, the initial weight and moisture content were 2610 gm and 20% respectively, whereas after storage period, the weight and moisture content were found to be 2486 gm and 22.9% respectively (Table 1). Close observation of each dried fish revealed that 16% fishes were light damage and another 16% medium damage (Fig. 1). The combined effect of insects infestation and rising of moisture content leads to a weight change of -0.96% with an effective weight loss (solid) of -3.63%. In this treatment 28 larval Darmestes and 5 larval Necrobia were found to be present (Table 2).

In 0.03% treatment of primiphos-methy, the initial weight of the dried fishes were 2650 gm and its moisture content was 18.8%. After storage period, the moisture content raised from 18.8 to 22.6%, although the final weight was tended to suffer

64 gm weight loss and the percentage weight change was -2.28% (Table 1). This loss was due to increasing rate of beetle infestation than the above two experiments (0.12% & 0.08% primiphos-methy). The corresponding adult dead and alive were 4 & 10 for Darmestes spp. and for Necrobia rufipes were 2 & 1 respect iively. The degree of damage (Table 2, Fig. 1) 48% were light damaged, 24% medium and 12% were highly damaged. The degree of infestation indicates that the concentration of 0.03% primiphos-methyl was ineffective against infestation.

In saturated brine treated dried fish, the initial weight and moisture content were 2610 gm and 20% respectively. At the end of the experiment, moisture content was found 24%, which was higher than the above experimented fish. The brine treatment gave little protection against beetles infestation. So the final weight was lower than the initial which leads to a weight change -1.29% and corresponding effective weight loss (solid) was -5.45% (Table 1). After thorough inspection, the fishes were graded as per degree of damage i.e. 60% were light damaged, 20% medium damaged and 4% were highly damaged (Fig. 1). Here 52% fishes were contaminated with dead skin and casts (Table 2). The excellent rise of moisture content was probably due to the hygroscopic nature of sodium chloride (NaCl).

The last batch of dried fishes treated with dried 'Bishkattali' herb al plants. The philosophy of this treatment adopted considering the indigenous preserving dry Chilli by the rural people. The initial weight of the fish at 18.3% moisture content was 2660 gm. After scheduled storage period, moisture content was found 21.8% and the actual weight was 2490 gm. The insects infestation leads to a weight of -2.73% and an effective weight loss (solid) of -5.63% (Table 1). The preserving effect of dried 'Bishkattali' against beetles infestation was more or less similar with the dose of 0.03% primiphos-methyl treatment.

The untreated control dried fishes were placed in the same premises to find out the comparative degree of control measure of each treatment against insect infestation and also to determine the perpetuation of insect infestation that are
faced by the 'Artohadar' at storage. This control fishes were severely infested and most of the fishes were completely hollowed out by the beetles larvae and some of the larvae have left for pupation. The total appearance of the paste suggested that the infestation had passed its peak one week previously. All the fishes (92%) had numerous casts (Table 2). Among all the treatment 0.12 and 0.06% pirimiphos-methyl treated fish showed comparatively good result against beetles infestation during storage. The 0.12% pirimiphos-methyl treated fish showed weight change of +2.94% which was economic to the traders. The treatment of 0.12% and 0.06% pirimiphos-methyl may be suggested as a dose of proper treatment.

Discussion
During storage, the untreated river fish suffered due to infestation by Derrnastes spp. and Neocrita rufipes (Table 2). The danger of infestation was reflected in the treatment damage (Fig. 1). The treatment of 0.03% pirimiphos-methyl, saturated brine and dried 'Bishkatali' (Polygonum hyncypiper) showed more or less same preserving action where effective weight losses were around 8%. In case of untreated control the effective weight loss was of about 25.47%. The treatment of 0.12% and 0.06% pirimiphos-methyl gave better protection against beetles infestation. The damage was less and the larvae were apparently, newly hatched. Except 0.12% pirimiphos-methyl treatment all other treatments showed negative weight change i.e. weight loss due to beetles infestation instead of rising moisture content in storage. The 0.12% pirimiphos-methyl treatment showed positive weight change (+2.94%) due to control effect of 0.12% pirimiphos- methyl and the addition of moisture during storage. Indonesian code of practice, for fresh and cured fish (Walker, 1984b), it was stated that when the air relative humidity is greater than 75% renutation of dried fish will be obviously happened if the product is not wrapped with polythene or other. This statement in close agreement with the present finding. FAO (1981) stated the same opinion that in an atmosphere having humidity greater than 60%, the dry fish will tend to pick up moisture, with consequent risk of spoilage. Walker (1984a) stated that in Malawi, traditional treatment included the use of pepper and powdered leaves of Bosia senegalensis and this gave some degree of protection against beetles infestation. In the present storage, experiment with dried 'Bishkatali' plants more or less showed some preserving action against beetles attack. The philosophy to use this plant is that the rural people preserve dried pepper with dried 'Bishkatali' and control some insects infestation. Rattagool et al. (1988) stated that in Thailand, infestation of Derrnastes maculatus and Derrnastes aier resulted heavy damage and physical loss of approximately 25% in smoked Arius spp. when kept in store over 15 weeks. The 0.03% pirimiphos-methyl dip reduced dermestid beetles infestation of salted dried fishes and in both 0.06% pirimiphos-methyl and 0.003% Deltamethrin dip resulted complete protection against beetles infestation for the same period and the moisture content of fish at the end of the experiment was found to be reduced by 30%. Deltamethrin 0.003% Deltamethrin which showed an increment of weight (about 1%) instead of light and medium infestation of 10% and 8% respectively. The present weight loss (25.47%) of untreated control was higher than the above authors and this was due to salt avoiding. In his study the beetles Derrnastes spp. appeared as a major insect infesting on dried fish, although Necrobia rufipes and mites, Lardoglyphus spp. were considered as minor pest. The work of Cole (1963) in Aden, Green (1967) in South Arabia, Aref et al. (1965) in Mal, Proctor (1972) in Zambia and Osugi (1973) in Nigeria left little doubt that under present commercial conditions, cured loss of dried fish during the final stage of drying but especially during storage and distribution of the infestation of Derrnastes spp., was higher. The present observation closely agrees with the authors.

Acknowledgments
Authority of Atomic Energy Commission, Dhaka, Bangladesh for their untiring guidance and assistance through out the laboratory analysis as well as their help rendered to identify of different infestators. Thanks are Dr. David James Walker (insect specialist, NRI, UK), FAO librarian (Rome, Italy) and Dr. Peter E. Doe (Senior Lecturer, University of Tasmania, Australia) for providing many valuable literatures, which were very much relevant and helpful for this work.

References