Research Paper

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Insecticidal Activity of Two Herbal Plant Extracts Against *Tribolium Castaneum* (Coleoptera: Herbst.)

Zoology

KEYWORDS : *T. castaneum, E. Jambolana* (Jamun) seed extract, *Aloe vera* (Grihta Kumari) gum extract.

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ABSTRACT

The stored food grain experiences major threat from insect pests. Tribolium castaneum is one of the major pests that infests and damages the stored food grains worldwide. This is a common pest in the commodities including grain, flour, peas, nuts, dried fruits etc. In this study the insecticidal activity of herbal plant extracts of Eugenia Jambolana (Jamun) seed and Aloe vera (Grihta Kumari) gum extracts were tested against the adults and larvae of Tribolium castaneum. The duration dependent increased percent mortality was observed with both the extracts and the mixture. The Aloe vera gum extract was found more effective than E. Jambolana seed extract after 96 hours in adults and larvae. In the mixture of the compounds a comparatively lower mortality was observed than the individual extracts. The Aloe vera gum extract exhibited a possibility to be an alternative to the synthetic insecticides in the management of T. castaneum pest.

Introduction

The red flour beetle *Tribolium castaneum* (Herbst) (Coleoptera : Terebrionidae) is a Cosmopolitan speices and causes considerable losses to the stored food grains. The management of storage food grain pests is not a current issue. Various recommendations of grain storage techniques, using different natural products to kill or keep away the infesting insect pests are advised by the researchers of yester years.

The red flour beetle *Tribolium castaneum* (Herbst) is a common and most destructive pest throughout the world and generally found in Granaries, Mills, Ware House, Wheat Flour etc. It causes serious damages to all kinds of stored grain products (Prakash *et. al*., 2008).

Currently different kinds of preventive and curative control measures are in practice to protect stored grains and flours from this pest. Among those, chemical or synthetic insecticides have been used for a long time. These chemicals have serious drawbacks, such as direct toxicity to beneficial insects, human and also the fertility of the land. Considering the issues related to synthetic insecticides and the traditional techniques, the bioefficacy of various plants extracts againts pulse beetles had been studied by various authors (Rahman and Talukder, 2006; Sagheer *et. al*., 2011)

The present investigation was undertaken to determine the efficacy of locally available herbal plant extracts, *Eugenia Jambolana* (Jamun) seed and *Aloe vera* (Grihta Kumari) gum, against stored grain insect pest *Tribolium castaneum*. It was aimed to investigate the effectiveness of these extracts on the mortality against adults and larvae of *T. castaneum* to minimize the use of synthetic insecticides.

Material and Methods

The wheat flour was sterilized at 60°C for 24 hours in an oven. A mixture of wheat flour with powdered dry yeast in a ratio of 19:1 was used as a food medium throughout the experimental period to maintain the culture. *T. castaneum* culture was obtained from National Chemical Laboratory, Pune. These cultures were kept under ambient conditions (28± 2°C and 65% R.H). The culture protocol of beetles was established to get a regular supply of the newly formed adults for the experiment.

E. Jambolana (Jamun) seed and *Aloe vera* (Grihta Kumari) gum extracts in powdered form were procured from M/s Amsar Laboratories, Indore (MP, India). The trial experiments were conducted using these extracts. The mean lethal dosage were analysed by Probit analysis by using Ehab Soft software. The experiment was designed at 8 gm concentration for both the individual extracts and mixture (1:1).

Methodology

The insecticidal activity of *E. Jambolana* (Jamun) seed and *Aloe vera* (Grihta Kumari) gum extracts were tested against i) Adult insects of *T. castaneum*, ii) Fifth instar larvae of *T. castaneum* and iii) A mixture of these extracts on adult *T. castaneum.*

In case of larval and adult bioassays both the plant extracts were measured (8 gm) and kept separately into small food grade plastic bottles (3 cm diameter X 2 cm height). There after ten adult insects and ten fifth instar larvae of *T. castaneum* were introduced into each bottle separately (Talukder and Howse, 1994). These bottles were then covered with a Muslin cloth to facilitate proper aeration and to prevent entry of other insects. Each treatment was performed in triplicates for both the extracts and kept on laboratory table for the observations. The insects were assessed for mortality / survival after the 24, 48, 72 and 96 hours durations.

Whereas, a mixture of *E. Jambolana* (Jamun) seed and *Aloe vera* (Grihta Kumari) gum extracts were measured (4 gm + 4 gm), mixed thoroughly in food grade bottles. Ten adults of *T. castaneum* were added into treated medium. Rest of the protocol remains same.

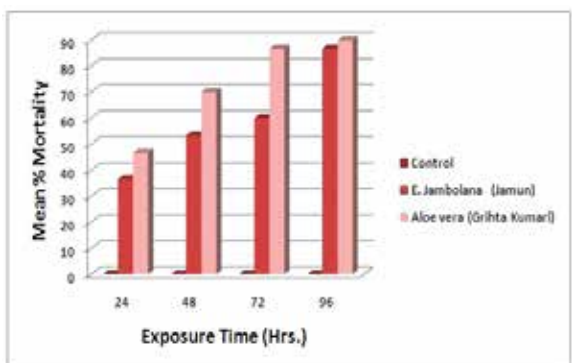
The means of mortality were calculated and further corrected by using the Abbot's formula (Abbott, 1925). Results were tabulated by calculating the Mean percent mortality and illustrated graphically.

Results and Discussion

i) Insecticidal activity of two plant extracts on adult insects of *T. castaneum.*

Compound	Mean Percent Mortality of adult *T. castaneum* against two herbal plant extracts (Hrs.)			
	24	48	72	96
Control	0	0	0	0
E. Jambolana (Jamun)	36.67	53.33	60	86.67
Aloe vera (Grihta Kumari)	46.67	70	86.67	90

Table 1.0 Mean Percent Mortality of *T. castaneum* against two herbal plant extracts



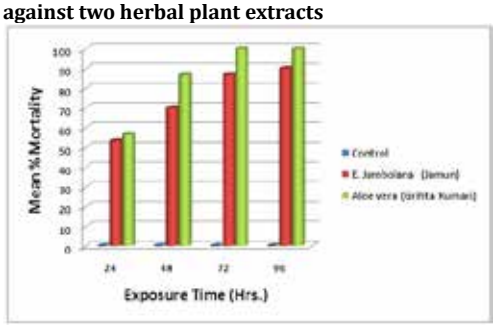
Graph 1.0 Mean Percent Mortality of *T. castaneum* against two herbal plant extracts

The effects of 8 gm concentration of *E. Jambolana* (Jamun) seed and *Aloe vera* (Grihta Kumari) gum extracts against the beetle, *T. castaneum*, were presented in Table 1.0 and Graph 1.0. The mean percent mortality of the red flour beetle at 24, 48, 72 and 96 hours is higher in the *Aloe vera* (Grihta Kumari) gum extract. The duration dependent increased percent mortality was observed in both the extracts after intervals of 24, 48, 72 and 96 hours. The *Aloe vera* (Grihta Kumari) gum extract was found to be more effective than *E. Jambolana* (Jamun) seed extract as highest mean percent mortality was observed as 90% after 96 hours.

ii) Insecticidal activity of two plant extracts on fifth instar Larvae of *T. castaneum*

Compound	Mean Percent Mortality of *T. castaneum* Larvae against two herbal plant extracts (Hrs.)			
	24	48	72	96
Control	0	0	0	0
E. Jambolana (Jamun)	53.33	70	86.67	90
Aloe vera (Grihta Kumari)	56.67	86.67	100	100

Table 2.0 Mean Percent Mortality for Larvae of *T. castaneum* against two herbal plant extracts



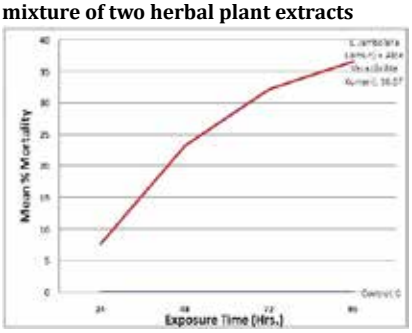
Graph 2.0 Mean Percent Mortality of Larvae of *T. castaneum* against two herbal plant extracts

The effect of 8 gm concentration of the *E. Jambolana* (Jamun) seed and *Aloe vera* (Grihta Kumari) gum extracts against the fifth instar larvae of the beetle, *T. castaneum*, were presented in Table 2.0 and Graph 2.0. The mean percent mortality of fifth instar larvae of the red flour beetle at 24, 48, 72 and 96 hours is higher in the *Aloe vera* (Grihta Kumari) gum extract. It showed 100% mortality, as compared to the *E. Jambolana* (Jamun) seed extract which exhibited mean mortality of 90%, after 96 hours. Similar to the adult insects, the fifth instar larvae also showed the duration dependent increased percent mortality in both the extracts after intervals of 24, 48, 72 and 96 hours.

iii) Insecticidal activity of mixture of two plant extract against *T. castaneum*

Compound	Mean Percent Mortality of *T. castaneum* against two mixture of herbal plant extracts			
	24	48	72	96
Control	0	0	0	0
E. Jambolana (Jamun) + *Aloe Vera* (Grihta Kumari)	7.78	23.33	32.22	36.67

Table 3.0 Mean Percent Mortality of *T. castaneum* against mixture of two herbal plant extracts



Graph 3.0 Mean Percent Mortality of *T. castaneum* against mixture of two herbal plant extracts

The effect of a mixture of the *E. Jambolana* (Jamun) seed and *Aloe vera* (Grihta Kumari) gum extracts (4 + 4 gm) against the adults of *T. castaneum*, were depicted in Table 3.0 and Graph 3.0. The mean percent mortality of the red flour beetle was observed directly proportional to the exposure periods of 24, 48, 72 and 96 hours.

In the present investigation both the plant extracts were used in powdered form. The insect mortality may be due to blocking of spiracles of the test insects and death might have caused by asphyxia (Mulungu *et. al*., 2007; Fernando and Karunaratne, 2012). It was observed that there may be a direct relationship between particle sizes of the plant extract powders and insect mortality (Ofuya and Dawodu, 2002).

Further, it revealed that the plant extract powder may cause abrasion of insect cuticle. The abrasion of cuticle may lead to water loss. The water loss in the insect, ultimately results in its death (Sousa *et. al*., 2005). Though there was no direct evidence observed in the present investigation.

The mortality rate is very high in larvae as compared to the adult insects. The larvae started becoming inactive after the initial exposure to the extracts (Madhumalty *et. al*., 2007). It was observed that the larvae after the exposure of the extracts showed curling, agitation and abrupt movements. These symptoms may be an indication of neurotoxic effects of the experimental extracts on the larvae (Arora *et. al*., 2011). Further, the experimental extracts inhibited larvae growth and caused death (Boussaada *et. al*., 2008).

The observed differences in the mortality may be due to the extracts from different compounds and parts, i.e., seed extract of *E. Jambolana* (Jamun), *Aloe vera* (Grihta Kumari) gum extract and variations in the concentrations of the secondary metabolites. Secondary metabolites disrupt pathogen metabolism or cellular structure (Modupe and Musa, 2014). These may be more toxic to the larvae.

In the mixture of the seed extract of *E. Jambolana* (Jamun) and *Aloe vera* (Grihta Kumari) gum extracts in equal quantity (4 + 4 gm), the insect showed lower mortality as compared to the mortality in either of the extracts. The lower mortality may be because of the difference in the dose concentration. These mixtures may act as synergists (Fields *et. al*., 2010) or as antagonists (Kordali *et. al*., 2006). In this bioassay also the mortality was duration dependent, similar to individual extracts bioassays. However, it is necessary to isolate the bioactive compounds of these extracts; similarly field tests should be conducted before using commercially.

The results of the present study showed an initial step towards controlling the larvae and adult insects of *Tribolium castaneum* by using these extracts.

Conclusion

The present findings based on the laboratory experiments suggests that the powdered herbal plant extract of *Aloe vera* (Grihta Kumari) gum is more effective than the *E. Jambolana* (Jamun) seed extract against *T. castaneum*. These results showed that *Aloe vera* (Grihta Kumari) gum extract and *E. Jambolana* (Jamun) seed extract possesses various chemical constituents, which are effective against *T. castaneum*. These should be explored to understand the broad spectrum of biological activities of these plant extracts against the insect *T. castaneum*. This study indicates that the herbal plant extracts may help to avoid the use of synthetic insecticides. Further studies with these plant extracts may provide an appropriate formulation to achieve an eco-friendly herbal insecticide to prevent the stored food grains losses due to the red flour beetle *Tribolium castaneum*. However, before releasing it as new insecticide, further investigations are needed to understand the exact mode of action of *Aloe vera* (Grihta Kumari) gum and *E. Jambolana* (Jamun) seed extracts.

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