

Assessment of two herbal plant extracts against *Tribolium castaneum* (Coleoptera: herbst)



Zoology

KEYWORDS : *Tribolium castaneum*, *Momordica charantia*, *Camellia sinensis*.

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ABSTRACT

The insect pests cause major threats to the stored food grains. The red beetle, *Tribolium castaneum* is one of the major pests worldwide that causes serious damage to the stored food grains. It is observed in the commodities that includes flour, peas, nuts, dried fruits etc. This study was planned to understand the insecticidal activity of acetone solvents and powdered extracts of *Momordica charantia* (Karela) fruit and *Camellia sinensis* (Green Tea) leaf extracts against the adults and its fifth instar larvae of *Tribolium castaneum*. The acetone solvents of *Momordica charantia* (Karela) fruit and *Camellia sinensis* (Green Tea) leaf and their powdered extracts were not found effective against the adults and larvae of the insect *Tribolium castaneum*.

Introduction

The insect causing damages to the stored food grains is one of the major issues worldwide. The red flour beetle, *Tribolium castaneum* (Herbst) (Coleoptera Terebrionidae) is a cosmopolitan species that causes substantial losses to the stored food grains. Storage of grains is a serious problem (Haq *et al.*, 2005). The infestations of the stored food grains cause huge economical losses.

The studies had revealed that the *Tribolium castaneum* (Herbst) is the most destructive pest throughout the world. It is generally found in Granaries, Mills, Ware Houses, Wheat Flour etc. It causes serious damage to all kinds of stored grain products (Prakash *et al.*, 2008).

Various insecticides are in use in the modern world. But, most of them are synthetic insecticides. Considering the issues related to synthetic insecticides and the traditional techniques, the bioefficacy of various plants extracts against beetles had been studied by various researchers (Rahman and Talukder, 2006; Sagheer *et al.*, 2011). The herbal insecticides are eco-friendly and safe (Zia A, *et al.*, 2011; Guruprasad, B. R. and Aklam Pasha, 2014, Elumalai, *et al.*, 2015). Few studies had revealed that the toxicity of bioactive compounds is responsible for the effectiveness of these plant extracts (Khalequzzaman, M. and Sultana S., 2006; Mamun *et al.*, 2009).

The present investigation was undertaken to determine the efficacy of locally available herbal plant extracts, *Momordica charantia* (Karela) fruit extract and *Camellia sinensis* (Green Tea) leaf extract, against adult *Tribolium castaneum* and its fifth instar larvae.

Material and Methods

The *T. castaneum* culture was obtained from National Chemical Laboratory, Pune. 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. These cultures were kept in BOD, 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. The 10-12 days old *T. castaneum* adults of mixed sex and its fifth instar larvae were used for the experiments.

Momordica charantia (Karela) fruit and *Camellia sinensis* (Green Tea) leaf extracts in powdered form were procured from M/S Amsar Laboratories, Indore (MP, India).

The trial experiments were conducted with acetone solvents. The extracts of *Momordica charantia* (Karela) fruit and *Camellia sinensis* (Green Tea) leaf were partially soluble in the acetone. The toxicity was tested with 0.2 ml and 1.0 ml concentrations (Begum M.; Sarker M. L., 2010; Mostafa M. *et al.*, 2012). The toxicity of the plants extracts was recorded after 24, 48, 72 and 96 hours.

The trial experiments were also conducted using in powdered form of these extracts. The experiment was designed at 8 gm concentration for both the individual extracts. The mean lethal dosage were analysed by Probit analysis using Ehab Soft software.

Methodology

Extracts in Acetone Solvent

The bioassay was performed by Film Residue method (Busvine, 1971). The solvents were prepared in Acetone, in which extracts were partially soluble. From the stock solution, 0.2 ml and 1.0 ml concentrations of both the extracts were tested for 24, 48, 72 and 96 hours in triplicate.

The higher concentrations were not considered because after drying, the extracts were forming a thick layer and scaling off from the petri dishes.

The acetone extracts with the above mentioned concentrations were tested for the live adult insects and fifth instar larvae for above said durations and mortality was observed. The experiments were performed in triplicate and the data was analyzed to calculate mean percent mortality and was corrected (Abbott, 1925).

Powdered Extracts

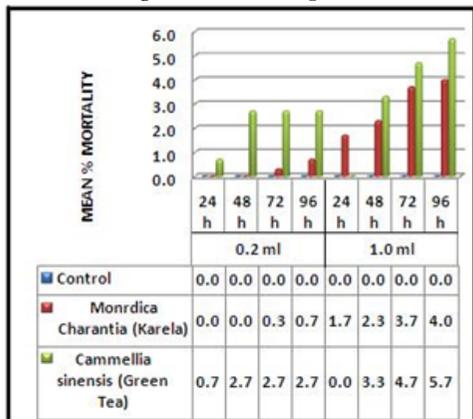
In case of adult and larvae bioassays powdered extracts of *Momordica charantia* (Karela) fruit and *Camellia sinensis* (Green Tea) leaf were measured (8 gm) and kept separately into small food grade plastic bottles (3 cm diameter X 2 cm height). The ten adult insects and ten fifth instar larvae of *T. 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 triplicate and kept on laboratory table for the observations. The mortality / survival were observed after the 24, 48, 72 and 96 hours durations.

The mortality were calculated and further processed as was in acetone solvents.

Results and Discussion

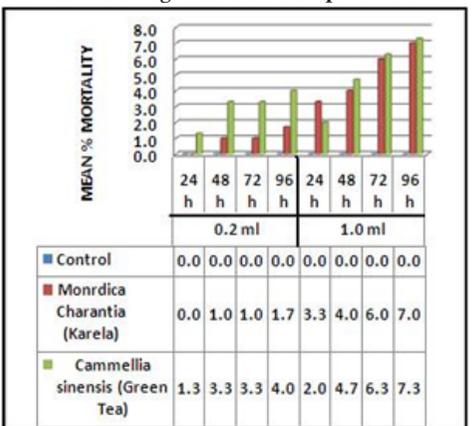
The mortality of adult *T. castaneum* in both the extracts with Acetone solvents, after 24, 48, 72 and 96 hours was very less. It was observed that, adults of *T. castaneum*, at 0.2 ml concentration of Karela extract acetone solvent showed 0.7% and of Green Tea showed 2.7% mean percent mortality after 96 hours of exposure. However, in 1 ml concentration of the plant extracts of Karela showed a mortality of 4% and Green Tea showed mortality of 5.7%, after 96 hours.

Fig. 1.0 showing Mean Percent Mortality of adults of *T. castaneum* against two herbal plant extracts in acetone



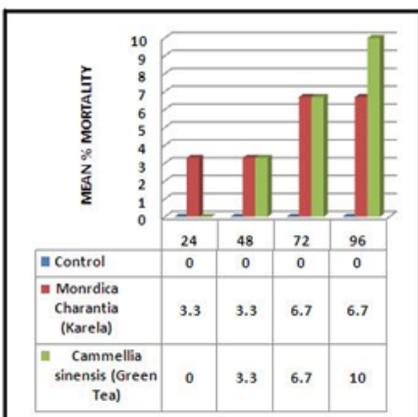
The study exhibited that the mortality of fifth instar larvae of red beetle were little more sensitive in Green Tea solvent than of the Karela extract. At 0.2 ml concentration Green Tea extract showed 4.0% mortality and Karela extract showed 1.7% mortality after 96 hours of exposure. However, 1 ml concentration of Green Tea and Karela extracts showed mortality of 7.3% and 7.0% respectively.

Fig. 2.0 showing Mean Percent Mortality of fifth instar larvae of *T. castaneum* against two herbal plant extracts in acetone



Both the extract in acetone solvents showed very less mortality. It may be due to their partial solubility in acetone. The partial solubility of the extracts in acetone might also lead to failure in controlling the insecticidal activity. Some other solvents may also be used to confirm the same.

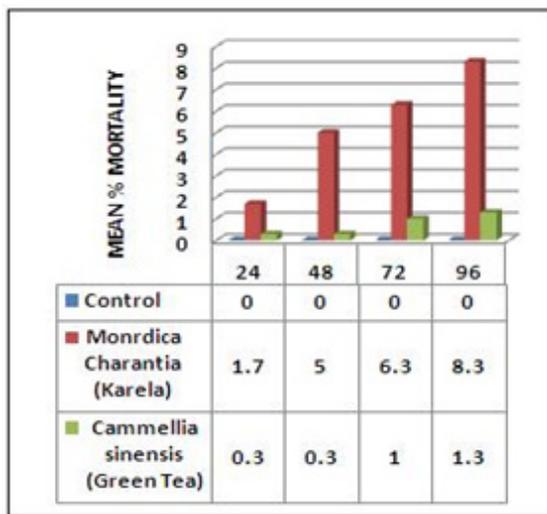
Fig. 3.0 Mean Percent Mortality of adult *T. castaneum* against two powdered herbal plant extracts



The mean percent mortality in 8 gm concentration of *Momordica charantia* (Karela) fruit and *Camellia sinensis* (Green Tea) leaf extracts against adults *T. castaneum*, at the intervals of 24, 48, 72 and 96 hours was almost negligible. The highest mortality observed was 6.7% in *Momordica charantia* and 10% in *Camellia sinensis* respectively after 96 hours. Whereas, the mean percent mortality of fifth instar larvae in *Momordica charantia* (Karela) fruit (8.3%) was higher than the *Camellia sinensis* (Green Tea) leaf extract (1.3%) after 96 hours.

Similar to the adult insects of *T. castaneum*, the mean percent mortality of the fifth Instar larvae, after the intervals of 24, 48, 72 and 96 hours in both the extracts was also ineffective.

Fig. 4.0 Mean Percent Mortality for fifth instar larvae of *T. castaneum* against two powdered herbal plant extracts



The secondary metabolites play an important role in the insecticidal activity (Modupe and Musa, 2014). In the previous studies, the mortality due to the abrasion of insect cuticle (Sousa *et al.*, 2005) and neurotoxic effects on larvae (Arora *et al.*, 2011) with various extracts were observed.

In this study the Karela fruit and Green Tea leaf acetone solvents and powdered extracts were found ineffective to control the adult and fifth instar larvae of *T. castaneum*. It was observed that the least ash and protein contents of the extracts increases their effectiveness (Zia A, *et al.*, 2011). The chemical composition of the extracts used in present study exhibited high ash and protein contents, which might be the cause of ineffectiveness (Ramdin D, *et al.*, 2013; Muhammad A, *et al.*, 2013; Kandangath R A, *et al.*, 2015). However further studies are required to understand the chemical composition and other such causes of ineffectiveness observed in the present study.

Conclusion

The present findings based on the laboratory experiments of the acetone solvents of herbal plant extracts of *Momordica charantia* (Karela) fruit and *Camellia sinensis* (Green Tea) leaf extracts against *T. castaneum*, suggest that these extract solvents and powdered extracts were almost ineffective. In either conditions they did not exhibit significant mean percent mortality of the adult insects and fifth instar larvae. It can be concluded that the mortality was just equivalent to the control group.

However, more trial investigations are required to confirm the efficacy of these plants extracts against *T. castaneum*.

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References

- (1) Abbott, W.S. (1925). A method of computing the effectiveness of an insecticide. *Journal of Economic Entomology*, 18, 265-267.
- (2) Arora, M., Sharma, J. Singh, A. and Negi, R.S. (2011). Larvicidal Property of Aqueous Extracts of *Withania somnifera* on *Tribolium castaneum*, *Indian Journal of Fundamental and Applied Life Sciences*, Vol. 1 (2), pp. 32-36.
- (3) Begum M and Sarker M L (2010), Evaluation of some plant extracts against flour beetle. *J. Agrofor. Environ.* 4 (1): 81-84.
- (4) Busvine, J R (1971), A critical review of the techniques for testing insecticides. Commonwealth Agricultural Bureau, London. 345 pp.
- (5) Elumalai A, Krisnappa K, Kalaichelvi N and Elumalai K, (2015), Insecticidal, repellent and ovicidal activities of different solvent extract of *Rivina humilis* Linn. (Phytolaccaceae) against the selected stored grain pest, *Tribolium castaneum* Herbs. (Coleoptera : Tenebrionidae). *Int. J. Adv. Res. Biol. Sci.* 2(10): 161-169.
- (6) Guruprasad B R and Aklam Pasha (2014), Assessment of repellency and insecticidal activity of *Ajuga perviflora* (Benth) and *Trichilia connaroides* (W & A) leaf extracts against stored product insects. *Journal of Entomology and Zoology Studies*, 2 (4), 221-226.
- (7) Haq, T., N.F. Usmani and T. Abbas, 2005. Screening of plant leaves as grain protectants against *Tribolium castaneum* during storage. *Pakistan J. Bot.*, 37: 149-153
- (8) Kandangath R A, Garlapati P K and Nallamuthu I, (2015), Nutritional, Pharmacological and Medicinal properties of *Momordica charantia*. *Int. J. of Nutrition and Food Sciences*, 4 (1): 75-83.
- (9) Khalequzzaman, M. and Sultana, S., (2006). Insecticidal activity of annona squamosa L. seed extracts against the red flour beetle, *Tribolium castaneum* (Herbst). *J. biol. Sci.*, 14: 107-112.
- (10) Mamun MSA, Shahjahan M, Ahmad M. (2009). Laboratory evaluation of some indigenous plant extracts as toxicants against red flour beetle, *Tribolium castaneum* (Herbst) *Journal of Bangladesh Agricultural University*. 7, 1-5.
- (11) Modupe, M.A. and Musa, M. (2014). Prospect of antifedant secondary metabolites as post harvest material. *ijir set Vol. 3, (1)*, 8701-8708.
- (12) Mostafa M., Hemayat H., Hossain A, Biswas P K and Haque A Z, (2012), Insecticidal activity of plant extracts against *Tribolium castaneum* Herbst. *J. of Adv. Sci. Res.*, 3(3), 80-84.
- (13) Muhammad A., Asif A., Nauman K., Imran H. and Iftikhar A, (2013), Chemical composition and sensory evaluation of Tea (*Camellia senensis*) commercialized in Pakistan. *Pak. J. Bot.*, 45(3), 901-907.
- (14) Prakash, A., Rao, J. and Nandagopal, V. (2008). Future of Botanical Pesticides in rice, wheat, pulses and vegetables pest management, *Journal of Biopesticides*, 1(2), 154 - 169.
- (15) Rahman, A. and Talukder, F. A. (2006). Bioefficacy of some plant derivatives that protect grain against the pulse beetle, *Callosobruchus maculatus*. *J. Insect Sci.* 6:03, 1 - 10.
- (16) Ramdin D, Abdul Shakoor, Chaudhary and Chris J Seal (2013), Chemical Composition, Plant Secondary Metabolites, and Minerals of Green and Black Teas and the Effect of Different Tea-to-Water Ratios during Their Extraction on the Composition of Their Spent Leaves as Potential Additives for Ruminants. *J. Agric. Food Chem.*, 61 (20), pp 4961-4967.
- (17) Sagheer, M., Hasan, M.U., Latif M.A. and Iqbal, J. (2011). Evaluation of some indigenous medicinal plants as a source of toxicant, repellent and growth inhibitors against *Tribolium castaneum* (Coleoptera: Tenebrionidae). *Pak. Entomol.*, 33 (2), 87-91.
- (18) Sousa, A.H.D., Maracaja, P.B. Silva, R.M., Moura, M.N. and Andrade, W.G. (2005). Bioactivity of vegetal powders against *Callosobruchus maculatus* (Coleoptera: Bruchidae) in caupi bean and seed physiological analysis. *Revista de Biologica E Ciencias Da Terra* 5, 19-23.
- (19) Talukder, F.A. and Howse. P.E. (1994). Efficacy of pithraj (*Aphanamixis polystachya*) seed extracts against stored-product pests. *Proc. Int. Working Conf. on Stored-prod. Protec.* 2, 848-852.
- (20) Zia A, Asla M, Naz F, and Iliyas M, (2011), Bioefficacy of some plant extracts against Chickpea beetles, *Callosobruchus chinensis* Linnaeus (Collioptera: Bruchidae) attacking Chickpea. *Pak. J. Zool.*, vol. 43(4), pp 733-737.