

ORIGINAL ARTICLE**Antifeedant activity of three plant extracts against *Tribolium castaneum* (Herbst)****S N Bhalerao**

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Email: bhalerao.sangeeta@rediffmail.com**ABSTRACT**

Conventional synthetic insecticides are dangerous for the environment and human health. Alternatively the herbal plant extracts are being tried to eliminate the insect pests. The insecticidal activities of these plant extracts may provide us safe and environment friendly insecticides. The red beetle insect *Tribolium castaneum* (Herbst) is a major threat to stored grains and the flours. Considering this, the Ashwagandha (*Withania somnifera*) Root, Adulsa (*Adhatoda vasica*) Leaf and Aloe vera (*Grihtkumari*) Gum extracts were tested against the insect pest *Tribolium castaneum* (Herbst). The antifeedant potential of these plant extracts was determined by the antifeedant index test using wheat wafer discs. Total coefficient of Deterrence was determined for each extract. After five days the effectiveness of the extracts against the insect pest *Tribolium castaneum* (Herbst) was analysed. The results revealed that Aloe vera gum extract has potential as an antifeedant.

Key words: *Tribolium castaneum*, Antifeedant, Ashwagandha (*Withania somnifera*), Adulsa (*Adhatoda vasica*), Aloe vera (*Grihtkumari*)

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INTRODUCTION

Grains are the key constituents for feeding the growing human population. Harvest grains are basic human food products [1]. The Grain production has been steadily increasing. Post harvest, the grains are usually stored on-farm, in large storage yards, etc. This flour is stored for the future consumption without causing any loss by any means. The stored grains need to be protected from infestation of insect pests. The insect pests cause the loss of weight of stored products and the food products become unfit for consumption due to the presence of pests [2]. The red flour beetle *Tribolium castaneum* (Herbst) (Coleoptera: Terebrionidae) is a cosmopolitan species and causes considerable losses as a storage pest [3].

Various preventive and curative measures are applied to protect stored grains and flours from this pest. Generally chemical or synthetic insecticides have been used. These chemicals have serious side effects, such as direct toxicity to beneficial insects, human and even to the fertility of the land. Regular applications may cause increase in pest resistance to pesticides, pest revival, and lethal effects on non-target organisms [4, 5].

Considering the drawbacks of synthetic insecticides and the traditional techniques, the bio efficacy of various plants extracts against pulse beetles had been studied by various researchers [6, 7]. In light of the side effects of synthetic insecticides a basic comparative study among Ashwagandha (*Withania somnifera*) Root, Adulsa (*Adhatoda vasica*) Leaf and Aloe vera (*Grihtkumari*) Gum extracts was aimed to observe and analyze their antifeedant activity against the insect pest *T. castaneum*.

MATERIAL AND METHODS

Extracts

The extracts of Ashwagandha (*Withania somnifera*) Root, Adulsa (*Adhatoda vasica*) Leaf and *Aloe vera* (Grihtkumari) Gum extracts in powdered form were procured from M/s Amsar Laboratories, Indore (MP, India) and used for the trial experiments.

Insect Culture

Target species of stored grain insect, *Tribolium castaneum*, used in these experiments were reared under controlled conditions of temperature, humidity and light. The wheat flour was sterilized at 60°C for 24 hours in an oven. A mixture of wheat flour with powdered Brewer's 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 standard culture protocol of beetles was established to get a regular supply of adults for the experiments.

The bioassay was performed according to the Choice and No Choice method [8] with some modifications. To observe antifeedant activity, 1 gm of wheat flour was mixed with 30% (0.3 mg) of each extract and two untreated discs (Control) composed of pure food, one treated with extract and one untreated discs with the possibility of choice and two treated discs by mixing the extracts in wheat flour for No Choice test were prepared. The wafer discs were made by using distilled water. These discs were baked in the oven at 40° C for 15 to 20 minutes.

The initial weight of the discs were observed and transferred in the food grade plastic bottles into which ten adult insects were released. The experiment was set up for 5 days. The discs were weighed five days after the test insects fed on them. The experiments were carried out in triplicate and the data was analyzed by analysis of variance (ANOVA).

Insects feeding were recorded under the following conditions:

- (1) On pure food composed of two untreated disc (control: CC);
- (2) On food with possibility of choice with one untreated (C) and another treated (E) disc (Choice test: CE);
- (3) On food with the tested extracts composed of two treated disc (No Choice test: EE)

The loss in weight of each set of discs (amount consumed) after 5th day was used to calculate the antifeedant index "T".

The antifeedant index (9) provides the measure of the substance unpalatableness, which was reported as antifeedant scale. This scale infers that: (T) values from 151 to 200 as excellent (++++), 101 to 150 as good (+++), 51 to 100 as medium (++) , while 1 to 50 (+) as mild antifeedant action. However, a negative (T) value suggests that the substance is an insect attractant. The antifeedant Index (T) was calculated as under:

$T = A + R$, A is Absolute Deterrent Coefficient; R is Relative Deterrent Coefficient

Where, $A = \frac{CC - EE}{CC + EE} \times 100$ (No Choice test)

and $R = \frac{C - E}{C + E} \times 100$ (Choice test).

RESULTS and DISCUSSION

The insects were treated with Choice and No Choice methods to find out coefficient of deterrence. The antifeedant index provides the measure of the substance unpalatableness [9]. The antifeedant scale confirms that the substance is an excellent / good / mild antifeedant or an Attractant.

Table 1.0 Antifeedant Index of various Extracts against <i>T. castaneum</i> (Disc Method)					
Dose:	1 gm Wheat Flour + 30% Compound (0.3 mg);				
	No. of Adult (Mix) Insects - 10				
Sr. No.	Name of the Extract	Absolute Deterrent Coefficient (A)	Relative Deterrent Coefficient (R)	Total Antifeedant Index (T)	Efficacy of Extract
1	Ashwagandha	9.8	-23.81	-14.01	ATTRACTANT
2	Adulsa	-8.94	-47.13	-56.07	ATTRACTANT
3	Aloe vera	19.14	-13.85	5.29	MILD

The absolute and relative coefficients represent the No choice and Choice tests. Where the insects had No choice to choose between treated and control discs (No choice test). Here the adults consumed either treated or control discs, which produce a low absolute coefficient values. Whereas, when they got the opportunity to choose between treated and control disc (Choice test). The adults directed their food consumption to untreated one, which produced higher relative coefficient values.

In the present study, it was observed that after five days at 30% dose concentration, the Ashwagandha root and Adulsa leaf extracts showed negative antifeedant index (T) and therefore are the Attractants. However, the extracts of *Aloe vera* showed Mild antifeedant activity against the *Tribolium castaneum*.

In the present study the *Aloe vera* gum extract has exhibited potential to control the insect pest was in accordance with previous study [10]. This action could be due to the alimentary factor obstruction in the central nervous system of the insect *T. castaneum*. This may also be because of the protein suppression in digestive canal [11]. It was observed that the plants possess the bioactive compounds. The antifeedant activity may be due to the presence of active compounds in the extracts [8, 12]. The secondary metabolites might also be one of the possible causes for the deterrent activity. The secondary metabolites [13, 14] may have improved the antifeedant index. But it needs further study to understand the bioactive activities of the extracts.

CONCLUSION

Among all the tested extracts, *Aloe vera* gum extract was comparatively found effective. After five days with 30% dose concentration, the effectiveness of the extracts against the insect pest *Tribolium castaneum* (Herbst) was observed. The results revealed that *Aloe vera* gum extract has potential as an antifeedant. The mortality caused may be due to the stomach poisoning. Antifeedant activity of the plant extracts could be due to the presence of various bioactive compounds. However, it is necessary to isolate the bioactive and secondary metabolites of these extracts to understand the exact mode of action.

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