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INSECTICIDAL ACTIVITY OF *ACACIA CATECHU* BARK EXTRACT AGAINST FOUR STORED PRODUCT PESTS

M. KHATUN, D. TALUKDER AND A. HYE

Bangladesh Council of Scientific and Industrial Research Laboratories (BCSIR), Rajshahi, Rajshahi-6206.

Corresponding author & address: Debashish Talukder, Email: dtbcsir@gmail.com
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ABSTRACT

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Laboratories experiment were carried out to determine the efficacy of (+)Catechin based insecticidal product against four stored product pests *viz. Tribolium castaneum* (Herbst), *Tribolium confusum* Duval, *Callosobruchus chinensis* L. and *Sitophilus oryzae* L. Catechu was extracted from *Acacia catechu* Willd. (Leguminosae) bark then was processed to prepare (+)Catechin. Finally (+)Catechin based insecticidal product was prepared by treating with HCl and sodium bicarbonate. Results demonstrate that (+)Catechin based insecticidal product was effective against the insect species at all the duration but it did not produce any effect on *S. oryzae* at 24 hours interval. The susceptibility of the insect species was in the following order. *T. confusum* > *T. castaneum* > *C. chinensis* > *S. oryzae*; *T. confusum* > *T. castaneum* > *C. chinensis* > *S. oryzae*; *T. confusum* > *C. chinensis* > *T. castaneum* > *S. oryzae* and *T. confusum* > *C. chinensis* > *S. oryzae* > *T. castaneum* at 24, 48, 72 and 96 hours intervals respectively. It is striking to note that at all the duration lowest LD_{50} values were observed for *T. confusum* adults.

Key words: *(+)Catechin based insecticidal product, T. castaneum, T. confusum, C. chinensis and S. oryzae adults, Contact toxicity*

INTRODUCTION

During the past few decades, application of synthetic pesticides to control agricultural pests has been a standard practice (Rozman *et al.* 2007). But indiscriminate use of chemical pesticides have given rise to many serious problems including genetic resistance of pest species, environmental pollution, threat to wild life, motivation by weather, hazards from handling (Ahmed *et al.* 1981; Shahjahan and Amin, 2000). This has created a worldwide interest in the development of botanical pest control agent (Heyde *et al.* 1983). The main advantages of botanicals are that they are easily produced by farmers and are potentially less expensive.

Acacia catechu willd, (Leguminosae) is wildly grown in the northern part of Bangladesh, mainly in the Nawabganj, Rajshahi, Natore and Pabna district. This tree is mainly used for extraction of catechu and the wood chips are used for fire wood. Catechu is a brown colored material with bitter taste. From ancient time it is a permanent dye in India fast to light and washing after imparts brown color to cotton and silk fabrics. Catechu is generally used with betel leaf for chewing. Wad *et al.* (1977) reported the astringent properties in *A. catechu* extracts, which use in tanning. Catechuic acid is valued as a remedy in chest affection (Hye 2002). The main effective compounds of catechu are + Catechin, 3,5,7,3',4' pentahydroxy flavan (Hye *et al.* 2007). Therefore, present study was undertaken to investigate the insecticidal activity of *A. catechu* extract against four store product pests.

MATERIALS AND METHODS

The experiment was conducted in research laboratory of Bangladesh Council of Scientific and Industrial Research (BCSIR) Laboratories, Rajshahi, Bangaladesh during the month of August to November 2010. Stock culture of *C. chinensis* and *S. oryzae* were maintained in separate 1000ml beaker on sterilized cowpea and maize at $30^0C \pm 0.5^0C$ in an incubator respectively. A standard mixture of whole wheat flour with powdered dry yeast in a ratio of 19:1 was used as food medium in case of *T. castaneum* and *T. confusum* adults reared.

The extracted catechu was dissolved in about eight times to its own weight of boiling water and the liquid, after being strained through a cloth, should be set aside for one day until the insoluble catechin subsides. This should then be collected and placed under a screw-press, being thereafter dissolved in sufficient amount of dilute alcohol and filtered solution shaken up in ether. The ether is next removed by distillation, and the crystals obtained washed repeatedly in pure distilled cold water. (+)Catechin is prepared to exist in the form of almost colorless needles.

500g of (+)Catechin was dissolved in 1 litre of hot water. The solution was acidified with dil HCl. A brown precipitation of (+)Catechin developed was treated with sodium bicarbonate. The ppt. was dissolved with clear solution. It was then dried at 30^0C. A brown crystalline powdered was formed. It was highly soluble in water. Finally insecticidal product of (+)Catechin compound were prepared.

To test insect mortality four doses from (+)Catechin based insecticidal product were prepared including control. The doses were 39.29, 78.59, 157.19, 314.38 $\mu g/cm^2$. Ten days old of *T. castaneum*, *T. confusum, S. oryzae* and *C. chinensis* were taken from the stock culture. All the above doses were prepared by mixing the requisite amounts of the (+)Catechin based insecticidal product with 10 ml water. The experiment was carried out adopting the method of residual film technique. For each test dose 1ml liquid was dropped on a Petri dish (9cm

dia surface area 62.63cm^2) and then dried in an oven at 40^{0}C for 4 hours. Ten adults insect from each species were then released on to the Petri dish and these were kept in an incubator at 30 ± 1^{0}C, 70% relative humidity.

The doses were calculated by measuring the weight of plant product (mg) in 01 ml of the water divided by the surface area of the Petri dish and it is converted into μg/cm^2. The mortality was assessed after 24, 48, 72 and 96 hours of the treatment. The percentage of the mortality was corrected using Abbott's formula (Abbott 1925) and LD_{50} values were determined by probit analysis (Busvine 1971).

RESULTS AND DISCUSSION

The results of contact toxicity and statistical analyses have been presented in Table 1. For comparison of susceptibility LD_{50} values and regression equation of the test material against the four insect species were determined. The probit analysis of percent mortalities in all the cases gave χ^2 values at 2 degree of freedom and the significant χ^2 values were adjusted for heterogeneity. Results demonstrate that (+)Catechin based insecticidal product was effective against the insect species at all the duration.

At 24 hours duration the (+)Catechin based insecticidal product showed moderate effect against four stored grain pests, but did not cause any mortality in *S. oryzae*. The LD_{50} values of the product at 24 hours exposure time were 628.07, 888.47 and 951.35 μg/cm^2 against *T. confusum, T. castaneum* and *C. chinensis* adults respectively. According to susceptibility of store grain pests the order of efficacy following the order *T. confusum* > *T. castaneum* > *C. chinensis* > *S. oryzae*.

The LD_{50} values of the (+)Catechin based product at 48 hours intervals were 149.61, 168.74, 284.81 and 951.00 μg/cm^2 against *T. confusum, T. castaneum* and *C. chinensis* adults respectively. The order of efficacy according to insect susceptibility were *T. confusum* > *T. castaneum* > *C. chinensis* > *S. oryzae*.

The four stored product pests showed high susceptibility to the (+)Catechin based product after 72 hours exposure time. The LD_{50} values of the product were 79.02, 89.04, 126.10 and 315.88 μg/cm^2 against *T. confusum, T. castaneum*, *C. chinensis* and *S. oryzae* respectively. Their susceptibility followed the order *T. confusum* > *C. chinensis* > *T. castaneum* > *S. oryzae*. After 96 hours duration the insect species i.e. *T. confusum, C. chinensis*, *T. castaneum* and *S. oryzae* showed very high susceptibility to the product. The LD_{50} values of the (+)Catechin based product were 24.34, 57.26, 27.95 and 33.92 μg/cm^2 against *T. confusum, T. castaneum*, *C. chinensis* and *S. oryzae* adults respectively. The order of susceptibility were *T. confusum* > *C. chinensis* > *T. castaneum* > *S. oryzae*.

The (+)Catechin based product showed strong contact toxicity against four stored product pests at different concentrations and exposure times. The mortality increased with rising concentration from 78.59 to 471.55 μg/cm^2 and with exposure time 24 to 96 hours. In this experiment the slope of the mortality curve increased vertically with the increase of doses and exposure time (Fig. 1). *Sitophilus oryzae* was noted to be relatively more tolerant than *T. castaneum*, *T. confusum* and *Callosobruchus chinensis*. The product did not cause any mortality on *S. oryzae* during 24 hours but caused 50% and 95% mortality after 48 and 96 hours respectively. Nearly 60-70% mortality in the four species achieved at the lowest doses after 96 hours. In all of the concentration the (+) Catechin based product showed the outstanding result against the four insect pests after 96 hours treatment.

Our findings are in accordance with the findings of Mahfuz and Khanam (2007), who reported that petroleum ether extract of *D. stromonium*, *Corchorus capsularis, Aphanamixis polystachea* and *Jatropha curcas* exhibited piquant toxic effect against *T. confusum* Duval adults. The present results is in conformity with the results of Khanam *et al.* (2009) who reported that petroleum ether, acetone and methanol extract of *Trichosanthes palmata* seed showed strong toxic effect to the larvae and adults of *T. castaneum* and *T. confusum*. Kim *et al.* (2003) revealed the significant insecticidal activity of *Cinnamonum cassia* bark, oil, *Cocholeria aroracia* oil and *Brassica juncea* oil within 24 hours after treatment against adults of *S. oryzae* and *C. chinensis* using direct contact application methods.

Arabi (2008) reported that the oil of *Provskia abrotanoides* karel at 322 μl/1Liter air caused 100% mortality for *S. oryzae* and *T. castaneum* within 13 and 7 exposure time respectively. He also reported that mortality of *S. oryzae* and *T. castaneum* increases with the increases of the exposure time (2 to 15 hours duration) at all the concentration (32, 161, 322, 483 and 645 μl/1Liter air). Sahaf *et al.* (2007) revealed the significant insecticidal activity of *Carum copticum* essential oil against *S. oryzae* and *T. castaneum* adults. Result of the present study is in agreement with the results of Park *et al.* (2002), who reported that essential oil of *A. calamus* oil was toxic to *S. oryzae* and *C. chinensis* adults when applied tropically. Wanyika *et al.* (2009) reported that natural pyrethuum extract blended with cotton seed oil exhibited the highest mortality against the adult maize weevils, *Sitophilus ozeamais* Motschulsky. The present results supported the finding of Khanam *et al.* (2006) who reported that Petroleum ether extract of *Z. cassumunar* rhizome, *Thevetia neriifolia* leaf and *Thevetia neriifolia* root caused highest mortality than those of other solvent extract against *S. oryzae*.

Table 1. χ^2 values, regression equation, LD_{50} values and 95% confidence limits of (+)Catechin based insecticidal product against *T. castsneum*, *T. confusum, S. oryzae* and *C. chinensis* adults after 24, 48, 72 and 96 hours of treatment

Hours after treatment	Stored product pests	χ^2 values for hete-rogeneity	Regression equation	LD_{50} (μg/cm^2)	Fiducial limits	
					Lower	Upper
24	*T. castaneum*	0.65	Y= 0.98 + 1.36 X	888.47	253.57	3113.02
	T. confusum	0.21	Y= 0.98 + 1.43 X	628.07	257.68	1530.85
	C. chinensis	0.14	Y= 1.36 + 1.22X	951.35	231.18	3914.88
	S. oryzae	-	-	-	-	-
48	*T. castaneum*	0.52	Y= 2.10 + 1.30 X	168.74	100.14	284.33
	T. confusum	0.86	Y= 1.08 + 1.80 X	149.61	99.55	224.84
	C. chinensis	0.06	Y= 2.12 + 1.17X	284.81	155.90	520.32
	S. oryzae	0.15	Y= 1.36 + 1.22X	951.00	231.20	3915.08
72	*T. castaneum*	2.71	Y= 2.19 + 1.34 X	126.10	69.75	227.97
	T. confusum	0.79	Y= 2.20 + 1.43X	79.02	37.18	167.94
	C. chinensis	0.15	Y= 1.69 + 1.69X	89.04	48.84	162.32
	S. oryzae	0.51	Y= 1.74 + 1.30X	315.88	177.62	561.77
96	*T. castaneum*	0.41	Y= 2.28 + 1.55 X	57.26	22.88	143.32
	T. confusum	0.15	Y= 3.38 + 1.69X	24.34	3.16	187.23
	C. chinensis	0.67	Y= 3.28 + 1.19X	27.95	4.27	182.78
	S. oryzae	0.05	Y= 2.94 + 1.35X	33.92	7.66	150.10

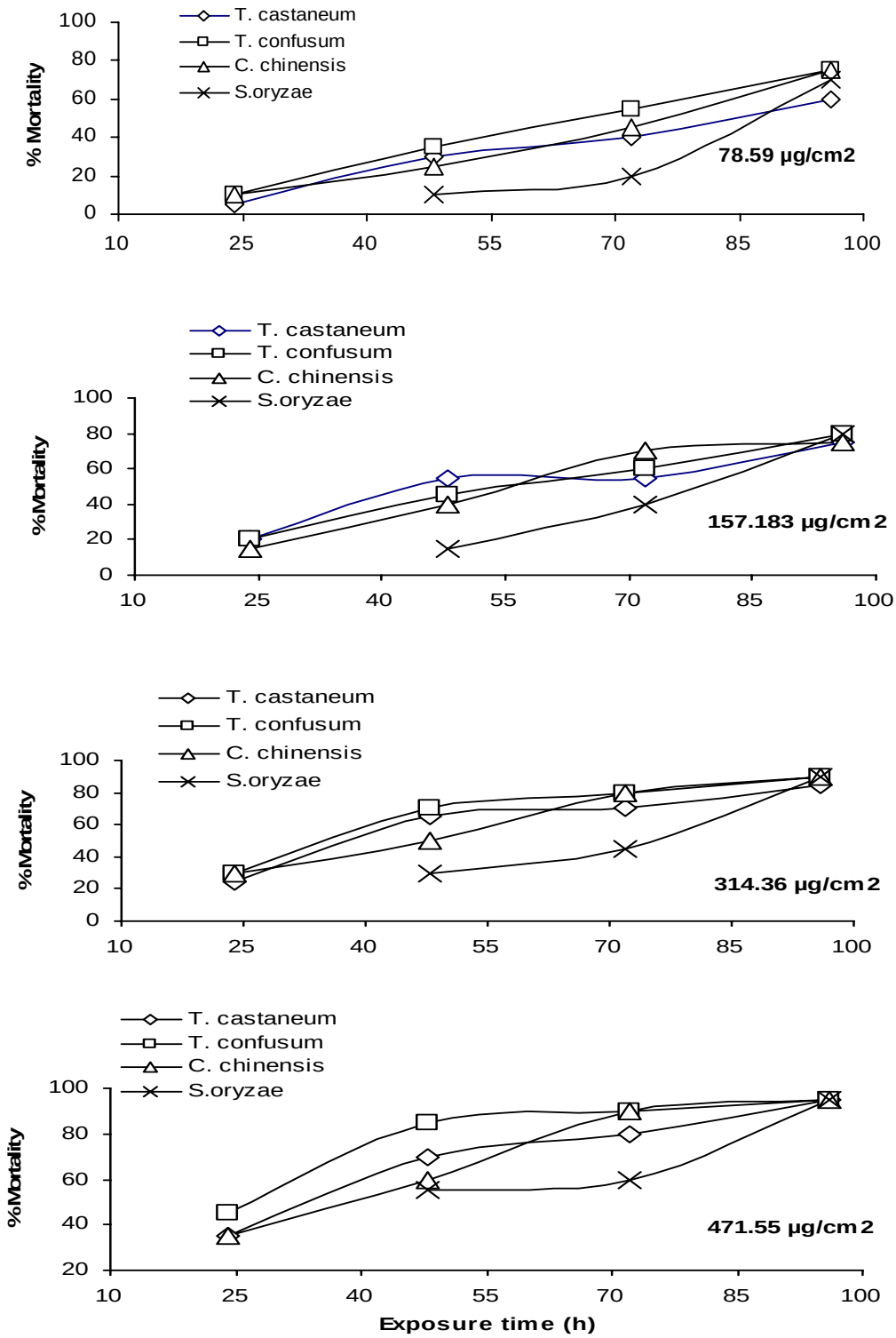

Fig. 1 Mortality (%) of *Tribolium castaneum, Tribolium confusum, Callosobruchus chinensis* and *Sitophilus oryzae* exposed to (+)Catechin based insecticidal product for various periods. Vertical bars indicate standard error of the mean

CONCLUSION

In four insect species the toxicity level of the (+)Catechin based product showed more or less similar at different exposure times. The findings of the present investigations indicate that the (+)Catechin based product might be useful as store product pest control agents for commercial use. To minimize the severe damage caused by insects pest, the traditional use of plant products, proved to be highly effective against store product pests.

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