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Scientific Note

Biological screening of *Curcuma longa* L. for insecticidal and repellent potentials against *Tribolium castaneum* (Herbst) adults

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The turmeric, *Curcuma longa* L. is a common spice belongs to the family Zingiberaceae. It is useful in disease of blood, leucoderma, scabbies, urinary discharges, inflammations, snake-bite, small pox, swelling, etc. (Kirtikar & Basu, 1935); in chronic otorhoea (Nadkarni, 1998); in antibacterial infection (Rambir Singh *et al.,* 2002). It contains ar-turmeron, ar-curcumene, α and β pineane sabinene, myrcene, α-terpinene, P-cymenene, perillyl-alcohol, turmerone, eugenol, iso-eugenol, etc. (Hussain *et al.,* 1992). However, *C. longa* has some phytochemical and medicinal properties, but its use for the control of crop pests and the information on its efficacy against stored grain pest is still scanty. So, the insecticidal and repellent activity tests of *C. longa* extracts have been attempted and the investigation has been designed to evaluate the efficacy of the test plant as a possible source of potential secondary metabolites to be used as environment friendly pest control agents.

Fresh aerial part and rhizomes of *C. longa* were collected from the adjacent areas of Rajshahi University Campus. The collected materials were dried under shade and powdered in a blender machine avoiding excess heat during blend. The ground materials were extracted with chloroform and left to evaporate for experimental use. The red flour beetle, *T. castaneum* were collected from the stock cultures maintained in the Crop Protection and Toxicology Laboratory, University of Rajshahi and reared in glass beakers (500 ml) with standard food medium (wheat flour: dry dust yeast. 19:1) (Khalequzzaman *et al.,* 1994; Park & Frank, 1948) in an incubator at 30°C $\pm$ 0. 5°C without light and humidity control for continuous supply of adults for the experiments.

For dose-mortality through surface film assay general concentrations for *C. longa* rhizome and aerial part extracts were selected as 50mg/ml and 90 mg/ml as the stock doses. The rhizome extract offered other successive doses 1.769, 0.885, 0.442, 0.221 and 0.111 mg cm^{-2} and the aerial part extract offered 3.185, 1592, 0.796, 0.398 and 0.199 mg cm^{-2} through serial dilution. Then 1 ml of each of the doses poured onto each of the Petri dishes (6 cm diam.) and let them dried out before releasing 10 beetles (of 3-5 days old) in each. Mortality of the beetles was counted after 24 and 48 h of exposure. The mortality (%) was corrected by Abbott's formula (1925) and the statistical analyses were done according to Finney (1947) and Busvine (1971) to find the LD_{20} values.

The repellency test used was adopted from the method of McDonald *et al. (*1970) with some modifications by Talukder & Howse (1993, 1994). For repellent activity tests a general concentration for both the extracts was taken. And 5mg/ml as stock dose to make other successive doses 0.157, 0.078, 0.039, 0.019 and 0.009 mg cm^{-2} by serial dilution. Half filter paper discs (Whatman No. 40, 9cm diam.) were prepared and treated with the doses separately and allowed them to dry out as exposed in the air for 10 minutes. Each treated half disc was then attached with untreated half with a scotch tape at the middle in such a way that attachment did not interfere with the free movement of insects. Then ten insects were released in the middle of each of the filter paper circles, and the whole experiment was set with 3 replications. Insects that settled on each half of the filter paper disc were counted after 1h and then at hourly intervals for 5 hours. The average of the counts was converted to percent repulsion (PR): PR = 2 (C-50); Where, C is the percentage of insects on the untreated half of the disc. Positive values expressed repellency and negative values for attractant actively.

The rhizome and aerial part extract offered dose mortality action against *T. castaneum* adults were found promising and the results have been presented in Table 1. The LD_{50} values for rhizome extract were 0.337 and 0.201 mg cm^{-2} for 24 and 48 h of exposure respectively while aerial part extract were 0.695 and 0.639 mg cm^{-2}. The rhizome extract was found stronger than the aerial part extract.

These findings have been supported by Tripathi *et al. (*2002) who evaluated oviposition-deterrent and ovicidal actions of *C. longa* leaf oil against *T. castaneum* and the oil was found insecticidal in both contact and fumigant toxicity assays. Ajaiyeoba *et al.* (2008) found the essential oils from the leaf and rhizome of this test plant to

control the malaria vector, *Anopheles gambiae* and the leaf oil showed fumigant toxicity as well. The petroleum ether extract of the leaves and rhizome exhibited toxicity towards the mosquito species: *Culex pipiens, C. quinquefasciatus, Aedes aegypti, Anopheles stephensi,* larvae (Latha & Ammini, 2000).

Table 1. Dose-mortality effects of *C. longa* extracts against *T. castaneum* adults

Test materials	Exposure (h)	LD_{50} value (mg cm^{-2})	Regression equation	χ^2 value (df)
Rhizome	24	0.337	Y = 4.265± 1.394 X	0.624 (3)
	48	0.201	Y = 4.361± 2.113 X	0.953 (3)
Arial part	24	0.695	Y = 2.887± 2.511 X	1.496 (3)
	48	0.639	Y = 2.728± 2.820 X	2.159 (3)

Chloroform extracts of the rhizome and the aerial part of *C. longa* showed strong repellent activity ($P < 0.001$) against *T. castaneum* adults. The F values were 15.22 and 131.22 and the P values were established as 2.58E-05 and 5.14E-12 for the analysis between doses. The aerial part extract was found weaker in comparison to the rhizome extract. These findings are in agreement with the report of Venugopal & Saju (1999) that *Curcuma* oil exhibits excellent insect repellent property even at 1% concentration in water. Findings of Thavara *et al.* (2007) give further approval of repellent activity of the volatile oil of *C. longa.*

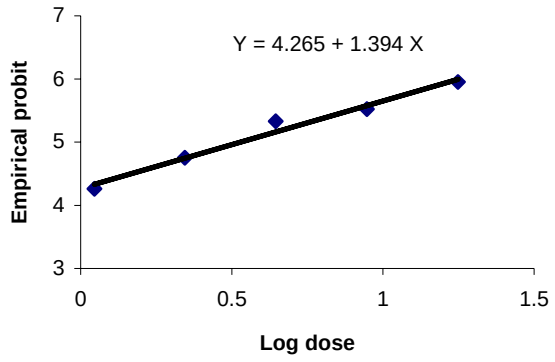

Fig. 1a. Probit mortality line of the rhizome extract of *C. longa* after 24 h of exposure

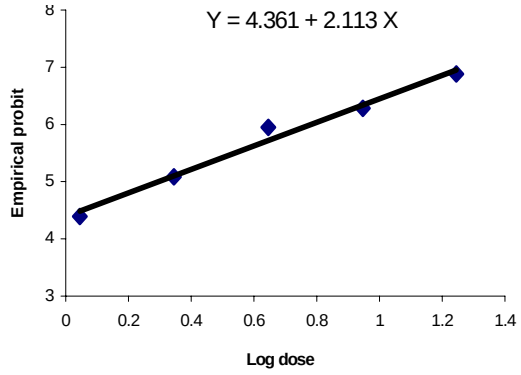

Fig. 1b. Probit mortality line of the rhizome extract of *C. longa* after 48 h of exposure

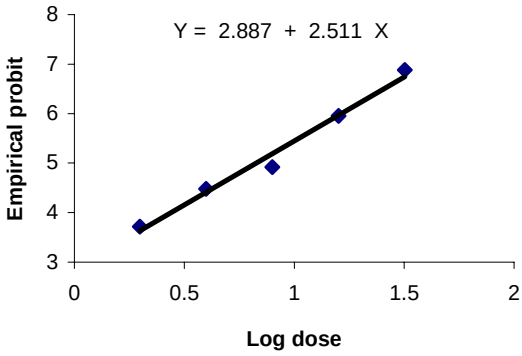

Fig. 2a. Probit mortality line of the aerial part extract of *C. longa* after 24 h of exposure

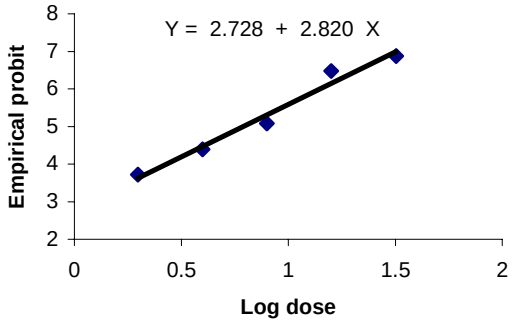

Fig. 2b. Probit mortality line of the aerial part extract of *C. longa* after 48 h of exposure

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