Biological activity of essential oils of *Alpinia conchigera* rhizome against *Sitophilus zeamais* and *Tribolium castaneum*

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Abstract

Research dealing with plant products is a new direction as an alternative to conventional insecticides for stored-product insect control (Shaaya et al., 1991, 1997). *Alpinia conchigera* Griffin (Zingiberaceae) is a native plant in southern Thailand, and it has a wide variety of the essential oils (Ibrahim et al., 2009). The toxicity and repellency of the water distilled essential oils from rhizome of *A. conchigera* was evaluated against the major stored-product insect pests, maize weevil, *Sitophilus zeamais* Motschulsky and red flour beetle, *Tribolium castaneum* (Herbst) 1-14 day-old adults at 29±2 °C and 65±5% r.h. In fumigation trials (Liu and Ho, 1999), the mortality was assessed at concentrations ranging from 74 to 667 µL/L in air with exposure times ranging from 3 to 24 h. There was complete mortality of *S. zeamais* at 222 µL/L after 24 h, whereas 593 µL/L for 24 h was required for complete mortality of *T. castaneum*. *Sitophilus zeamais* adults ($LC_{50,}$ fiducial limits: 121, 114-129 µL/L) were more susceptible to essential oils *of A. conchigera* than *T. castaneum* (295, 203-369 µL/L) (Table 1). Contact toxicity was assayed by topical application to insect thoraxes (Liu and Ho, 1999) at different concentrations (10 to 40%). *Sitophilus zeamais* adults ($LC_{50,}$ 27, 18-40 µg/mg) had the same mortality as *T. castaneum* ($LC_{50,}$ 34, 28-47 µg/mg) (Table 2). A filter paper choice bioassay (Ko et al., 2009) of essential oils of *A. conchigera* in 100% ethanol showed that *T. castaneum* has repelled more than *S. zeamais* (Table 3).

Keywords: Alpinia conchigera, Sitophilus zeamais, Tribolium castaneum, Essential oils, Toxicity

Table 1 Fumigation toxicity of essential oils from *Alpinia conchigera* rhizome against *Sitophilus zeamais* and *Tribolium castaneum* at 29 °C after 24 h.

Insect	LC_{50} (µL/L)	95% confidence Intervals (µL/L)	LC_{95} (µL/L)	95% confidence Intervals (µL/L)	Degrees of freedom	Chi-square
S. zeamais	121	113-128	180	168-196	8	0.395
T. castaneum	294	203-368	417	350-658	8	170.09

Table 2 Contact toxicity of *Alpinia conchigera* rhizome essential oils against *Sitophilus zeamais* and *Tribolium castaneum* at 29 °C after 24 h.

Insect	LC_{50} (µg/mg)	95% confidence Intervals (µg/mg)	LC_{95} (µg/mg)	95% confidence Intervals (µg/mg)	Degrees of freedom	Chi-square
S. zeamais	26	18-39	51	38-103	3	18.04
T. castaneum	34	28-46	60	47-101	3	9.33

Table 3 Percent repellency (PR) of *Alpinia conchigera* rhizome essential oils against *Sitophilus zeamais* and *Tribolium castaneum* using treated filter paper test*

Insect	Oil (µg/cm²)	PR (Mean% ± SD) Time after insect release (h)					
		1	2	3	4	5	PR (Mean%)
S. zeamais	0.16	32±59 **b**	36±59 **b**	56±38 **b**	68±41 **a**	60±47 **a**	50
	0.31	88±11 **a**	68±61 **ab**	76±26 **ab**	80±14 **a**	60±20 **a**	74
	0.47	96±9 **a**	96±9 **a**	88±18 **a**	72±30 **a**	72±33 **a**	85
	0.63	100±0 **a**	100±0 **a**	96±9 **a**	72±30 **a**	48±39 **a**	83
	0.79	100±0 **a**	96±9 **a**	96±9 **a**	80±45 **a**	60±14 **a**	86
T. castaneum	0.16	80±20 **a**	100±0 **a**	92±11 **a**	76±26 **b**	52±30 **b**	80
	0.31	72±18 **a**	80±25 **b**	92±11 **a**	80±14 **ab**	84±22 **a**	82
	0.47	84±17 **a**	96±9 **ab**	92±11 **a**	92±11 **ab**	100±0 **a**	93
	0.63	92±18 **a**	100±0 **a**	96±9 **a**	96±9 **ab**	80±28 **ab**	93
	0.79	96±9 **a**	96±9 **ab**	96±9 **a**	100±0 **a**	88±18 **a**	95

*Five replicates of 10 insects in each replication, for each insect, means in same column followed by the different letters are significantly (P>0.05) Duncan's multiple range test (DMRT).

References

Ko, K., Juntarajumnong, W., Chandrapatya, A., 2009. Repellency, fumigant and contact toxicities of *Litsea cubeba* (Lour.) Persoon against *Sitophilus zeamais* Motschulsky and *Tribolium castaneum* (Herbst). Kasetsart Journal Natural Sciences 43, 56-63.

Liu, Z.L., Ho, S.H., 1999. Bioactivity of the essential oil extracted from *Evodia rutaecarpa* Hook F. et Thomas against the grain storage insects, *Sitophilus zeamais* Motsch and *Tribolium castaneum* (Herbst). Journal of Stored Products Research 35, 317-328.

Ibrahim, H., Aziz, A.N., Syamsir, D.R., Ali, N.A.M., Mohtar, M., Ali, R.M., Awang, K., 2009. Essential oils of *Alpinia conchigera* Griff. and their antimicrobial activities. Food Chemistry 113, 575-577.

Shaaya, E., Kostjukovski, M., Eilberg, J., Sukprakarn, C., 1997. Plant oils as fumigants and contact insecticides for the control of stored-product insects. Journal of Stored Products Research 33, 7-15.

Shaaya, E., Ravid, U., Paster, N., Juven, B., Zisman, U., Pisarrev, V., 1991. Fumigant toxicity of essential oils against four major stored-product insects. Journal of Chemical Ecology 17, 499–504.