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THE BIOLOGICAL ACTIVITY OF KUMCHURA RHIZOME TO MELON FLY : I. CRUDE KUMCHURA BIOACTIVITY

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INTISARI

*Rimpang kencur (*Kaempferia galanga, *L.) yang banyak dipergunakan di berbagai negara Asia, diketahui memiliki kualitas sebagai pembunuh kutu kepala. Untuk mengetahui apakah kemampuan ini berpengaruh kepada serangga lain, suatu preparasi rimpang kencur diaplikasikan terhadap telur, larva, dan imago lalat buah mentimun (*Bactrocera cucurbitae*) Coquillet. Preparasi rimpang dicampur dengan pakan larva, yang juga digunakan untuk medium penetasan telur. Preparasi ini ternyata bersifat ovisidal pada nisbah konsentrasi minimum 1:4 (rimpang: pakan). Nisbah ini tidak menyebabkan kematian larva, namun perkembangan larva terhambat dan tertunda. Dalam uji penolakan bahan, secara proporsional semakin tinggi konsentrasi yang diujikan semakin sedikit lalat buah yang mendatangi, tetapi peletakan telur tidak dihambat.*

Kata kunci : Rimpang kencur, Bactrocera cucurbitae *Coquillet*

ABSTRACT

Kumchura (***Kaempferia galanga***, L.) rhizome, a herbal medicine and condiment used in many Asian countries, was known to possess licicidal quality. To ensure whether this quality extend to other insects, kumchura rhizome preparation was applied to eggs, larvae and adults of the melon fly, ***Bactrocera cucurbitae***, Coquillet. Crude preparation of the rhizome was mixed with larval diet, which was also served as a common artificial egg-hatching medium. The preparation proved to be ovicidal at minimum concentration ratio of 1:4, kumchura:larval diet. No such larvicidal effects were seen at the same ratio, the effects observed were larval development inhibition and delay. In the repellency tests, proportionally less melon flies were found on diet containing kumchura, but no effect on oviposition was observed.

Key words : Kumchura rhizome, *Bactrocera cucurbitae* Coaquillet

INTRODUCTION

Kumchura (*Kaempferia galanga*, L.; *kencur*, Jv. , Ind.), a rhizome producing plant from the Zingiberaceae family, is used throughout most of Asia and the Pacific as herbal medicine and condiment. In China, the rhizome was used as a cure for human hair and body lice (Smith and Stuart, 1973). A scientific study of its effect on other insects, however, has not been done; although the rhizome's properties were known for almost 80 years (Paniker et al., 1926). One constituent, ethyl-p-methoxy-trans-cinnamate, was shown to be cytotoxic by Kosuge et al. (1985), while Kiuchi et al. (1988) reported its larvicidal action toward human visceral parasitic nematode. As the laboratory experiments mostly dealt with kumchura extract, it is little known whether the crude preparation of kumchura would also be effective. Therefore crude kumchura preparations was tested to the melon fly, *Bactrocera cucurbitae* Coquillet, to observe crude kumchura activity toward insect. The melon fly was chosen as test-insect because of its notoriety as a major pest to as many as 36 species of vegetables and fruit plants belonging to 12 families (Hardy, 1949)

MATERIAL AND METHODS

Insects. Melon fly eggs and puparia were obtained from the USDA Tropical Fruit and Vegetable Research Laboratory, Manoa, Honolulu. The larvae were fed with a astandard ~~Tanaka *et al.*, 1969), while adult flies were -in-sugar hydrolysate mixture (3:1, w/w) water. Cucumber used for the feeding test were obtained from local supermarket and rinsed well to asure removal of possible insecticide residue.

Kumchura. Kumchura rhizomes were purchased from a local market in Yogyakarta, Indonesia. Rhizomes were grown in the same locale. They were washed, sliced and sun-dried until the water content was at minimum (weight was reduced by 25 - 40%). To obtain crude kumchura preparation, the dried material was blended with water (25 g of dried rhizome in 250 ml distilled water) to yield a paste-like preparation. Tests showed that this preparation was not toxic to adult melon flies.

Crude kumchura diet-incorporated test. Mixture of crude kumchura in larval diet (50%, 25%, 12.5%, and 6.25%, w/w) were made and newly oviposited melon fly eggs (20 each, four replicates per concentration) were placed on the mixtures. Development from hatch to adult were followed to monitor any effects on the flies. The observations included egg survival (percentage of egg hatching), larval survival (percentage of larvae pupariating), average number of days to reach puparial stage, puparial weight and length, and puparial survival (percentage of adult emerging).

Repellency to larvae. Mixtures of crude kumchura in larval diet (50%,25%, 12.5%, and 6.25% w/w) were prepared. About five to 10 g mixture were placed side by side with a control (acetone-mixed diet) in a Petri dish. Care was taken so that the two diets were well separated. Twenty one-hour-olds eggs were placed between the diets in a round wet cloth or filter paper. The number of larvae found on the treated and control diets were recorded 24 hours later. Four replicates were used for each treatment.

Repellency to adults. Crude kumchura preparation was mixed with cucumber juice in concentrations of 50%, 25%, 12.5%, and 6.25%. The repellent properties of the kumchura preparation was tested in an all-glass Y-choice olfactometer system. The kumchura mixture was placed in one arm of the olfactometer, while the other arm contained untreated cucumber juice. Twenty adult melon flies (ten males and ten females) were placed in the release chamber of the olfactometer. The number of flies migrating to either of the two test chambers were recorded.

Repellency to oviposition. Crude kumchura preparation was mixed with cucumber juice in concentrations of 50%, 25%, 12.5%, and 6.25%. Cotton wicks soaked with a given mixture were placed in egger cups which acted as oviposition attracting devices. Five pairs of five-day-old adult melon flies were placed inside each container, and provided with water and sugar-protein hydrolysate. The eggers were changed daily. The number of eggs deposited were counted daily for twenty days. There were four replicates for each mixture.

Data analysis. Data obtained were analyzed using statistical programs of SAS and SYSTAT, applying ANOVA, Duncan's Multiple Range, Tukey or t-tests, whenever deemed proper. Graphs were generated by Cricketgraph and Sigmaplot.

RESULT AND DISCUSSION

Diet-incorporated test. The crude kumchura-diet mixtures reduced the percentage of egg hatch, larval pupation and adult emergence when eggs were exposed to the mixture (Table 1), increased the duration of larval development, and reduced pupal weight and length (Table 2). Concentrations of 25% and 50% reduced egg hatch to zero. Concentrations of 6.25% and 12.5% also significantly reduced egg hatch, pupation and adult emergence when compared to the controls. There were no significant differences in adult emergences between 6.25% and 12.5% mixtures. The duration of larval development reared at 6.25% and 12.5% concentration levels were both significantly different to the controls (Table 2). But the average pupal weight and pupal length between treated and control flies were not. Clearly crude kumchura had ovicidal effect when given equal to or more than 25% of larval diet weight, while lesser amount would only prolong larval stage duration. It did not, however, affect the immature flies morphologically. This suggested an action of citotoxicity, as recorded by Kosuge et al. (1985) and Kiuchi *et al.* (1988).

Table 1. Effect of Crude Kumchura Mixture to Eggs, Larvae and Pupae

Mixture (conc.)	% egg hatch	% larva pupariate	% adult emerge
0.00 %	85.25 a	73.23 a	70.05 a
6.25 %	54.80 b	46.44 b	21.36 b
12.50 %	37.51 c	29.00 c	17.11 b
25.00 %	0	0	0
50.00 %	0	0	0

Values represents the means of four replicates after transformation to arcsine x.
Values in a column with the same letters are not significantly different
(Duncan's Multiple Range Test, F_{eh} = 44.885, F_{lp} = 81.782, F_{ae} = 23.907, df=2,9; $p<0.05$)
0 = treatments produced 100% mortality

Repellency to larva. Higher concentration of crude kumchura were effective in repelling melon fly larvae (Figure 1). Significant differences were observed between the number of larvae found in diets containing 6.25% and 50% kumchura. There were no significant difference in the number of larvae found at the 12.5% and 25% concentration levels, although the number were clearly lower than those found in 6.25% and higher than those found on 50% levels. T-test analysis between the number of larvae found in the treated and untreated diets for 6.25%, 12.5%, 25%, and 50% concentration levels produced t-values of 3.10, 3.87, 6.79, and 3.87, respectively. These values indicate that the number of larvae found in untreated diet were significantly different compared to those found in treated diet (t-table = 2.447; df = 6; n=20 and $p<0.05$). The larvae, therefore, had preference over untreated diet, and would avoid diets containing any concentrations tested.

Table 2. Effect of Crude Kumchura Mixture to Larval Development

Mixture (conc.)	Larval duration (days)	Pupal weight (mg)	Pupal length (mm)
0.00 %	6.905 ± 0.09a	13.46 ± 3.41a	5.16 ± 0.541a
6.25 %	8.406 ± 0.19 b	12.01 ± 3.38a	5.18 ± 0.701a
12.50 %	8.673 ± 0.11 b	11.07 ± 3.75a	5.40 ± 0.339a
25.00 %	0	0	0
50.00 %	0	0	0

Values represents the means of four replicates and their standard deviations. Values in a column with the same letters are not significantly different (Duncan's Multiple Range Test, F = 192.711, df=2,9; $p<0.05$ for larval duration; ANOVA, F_w = 0.583, F_l = 0.296, df=2,12; $p<0.05$ for pupal weight and length)
0 = treatments produced 100% mortality

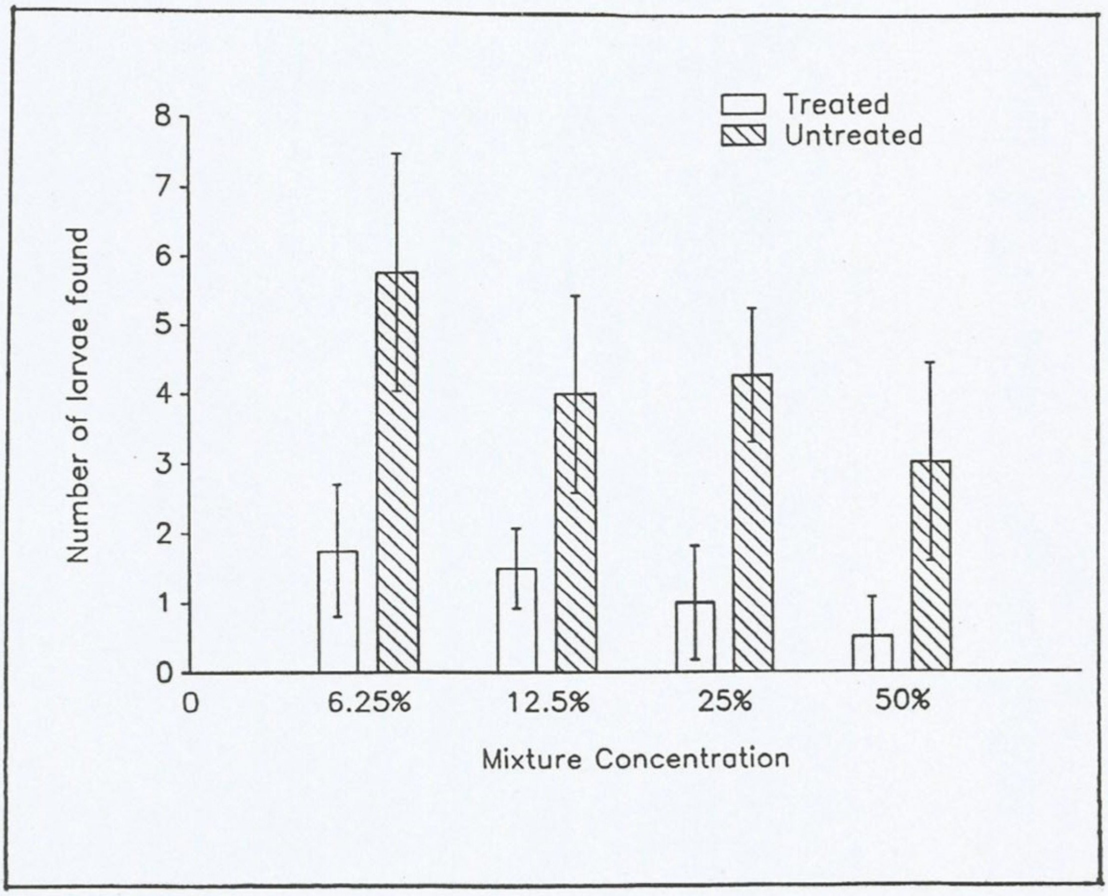

Figure 1. Crude kumchura repellency to melon fly larvae

Repellency to adult. The numbers of adult melon flies repelled by crude kumchura-treated diet decreased as concentration levels of kumchura in the diet increased (Figure 2). Significant differences were observed between the number of flies found in diets treated with 25% and 50% concentration levels compared to the 6.25% and 12.5% concentration levels. T-test analysis between the number of flies found in treated and untreated diets yielded t values of 2.902, 4.989, 6.291, and 35.109 for 6.25%, 12.5%, 25%, and 50% concentration levels, respectively. These figures confirmed significant differences between the number of flies found in treated diets and in untreated diets (t-table = 2.304, df = 8, n = 20, and $p<0.05$). Melon fly adults were repelled strongly by higher concentration of crude kumchura. The aroma (odor to some) of kumchura preparation is quite distinct, and it may possibly play a role in repelling those flies.

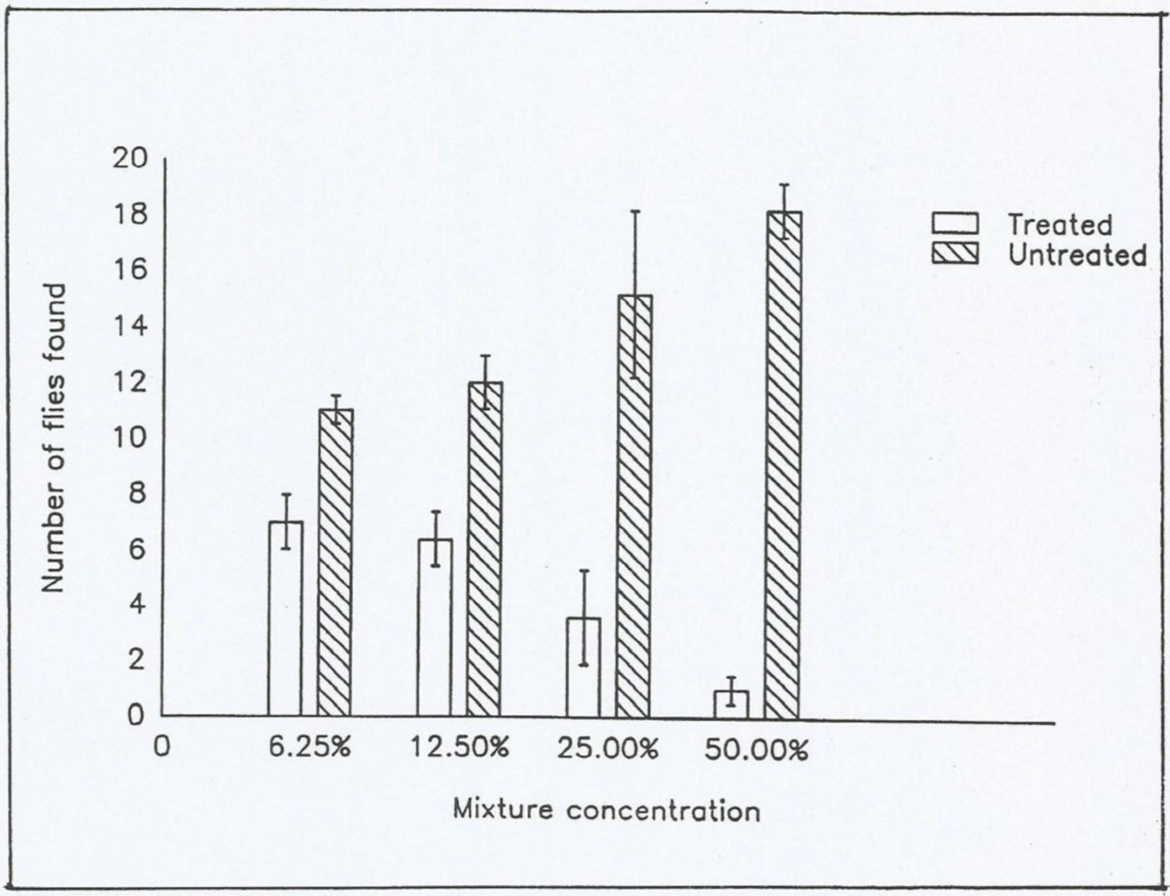

Figure 2. Crude kumchura repellency to melon fly adults

Repellency to oviposition. The total number of egg oviposited at 6.25% and 50% concentration levels were significantly lower than those produced by all other concentration treatments, including control. The 12.5% concentration, however, yielded higher number of total eggs than the control, which together with the 25% concentration level, did not differ significantly with the control. The result of this test, therefore, was inconclusive. A well-proven homogeneity of fecundity should be ensured for the test-insect, while other prerequisite for good oviposition scheme should also be observed.

These experiments showed that crude kumchura had bioactivity to the melon fly, which in farmers' level would be useful as crude kumchura will need no extraction before being used. The kumchura rhizome may then be utilized directly, and by developing easy-to-practice technology, farmers may use it as an alternative to protect their produces from the melon fly.

Table 3. The number of eggs oviposited in media mixed with crude kumchura preparations

Mixture concentration	Total egg laid	Egg laid/day
0.00 %	829.25 ± 128.44a	41.46 ± 12.84a
6.25 %	400.50 ± 162.66 b	20.03 ± 16.27 b
12.50 %	934.25 ± 206.75a	46.71 ± 20.68a
25.00 %	811.00 ± 84.39a	40.55 ± 8.48a
50.00 %	412.00 ± 56.14 b	20.60 ± 5.61 b

Total egg laid numbers are means and their standard errors of four replicates, each consisted of five pairs of adult melon fly caged for twenty days. Means in a column with the same letter are not significantly different (Duncan's Multiple Range Test, $F = 3.55$, $df = 4,15$; $p < 0.05$).

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