ACARICIDAL ACTIVITY OF FIVE MARINE ALGAE EXTRACTS ON FEMALE *BOOPHILUS MICROPLUS* (ACARI: IXODIDAE)

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ABSTRACT

The present report is the first ever on the acaricidal activity of marine plant extracts on *Boophilus microplus*. Topical application of crude ethanol extracts of five marine algae; namely *Laurencia obtusa, Padina vickerisiae, Liagora farinosa, Liagora elongata* and *Stypopodium lobatum*; affected the survival of engorged adult female *B. microplus* and inhibited oviposition and embryogenesis in the ticks.

The order of toxicity of the extracts (% adult mortality) on *B. microplus* was *Laurencia obtusa* (40.00%) > *Liagora elongata* (30.00%) *Liagora farinosa* (10.00%) = *Padina vickerisiae* = *Stypopodium lobatum*. However, the order of inhibition of embryogenesis was different from adult mortality [*Laurencia obtusa* (59.23%) > *Liagora farinosa* (38.75%) > *Stypopodium lobatum* (34.40%) > *Padina vickerisiae* (14.00%) > *Liagora elongata* (11.21%)].

RESUMEN

Este es el primer reporte sobre la actividad de acaricidas obtenidos a partir de extractos de plantas marinas sobre *Boophilus microplus*. La aplicacion de extractos crudos de cinco algas marinas, *Laurencia obtusa, Padina vickerisiae, Liagora farinosa, Liagora elongata* y *Stypopodium lobatum*, en etanol, afectan e inhiben la oviposicion y la genesis embriologica de las garrapatas.

La escala de toxicidad de adultos de *B. micropulus* fue: *Laurencia obtusa* (40.00%) > *Liagora elongata* (30.00%) *Liagora farinosa* (10.00%) = *Padina vickerisiae* = *Stypopodium lobatum*. Sinembargo, la escala de inhibicion de genesis embriologica fue diferente de la mortalidad de adultos: *Laurencia obtusa* (34.40%) > *Padina vickerisiae* (14.00%) > *Liagora elongata* (11.21%).

Extensive investigations of terrestrial natural products over the last two decades to replace the persistent organochlorine and organophosphorous pesticides have been done (Grainge et al, 1986). The need for more effective acaricides for the Caribbean region is demonstrated by the annual financial loss from the livestock industry due to tick infestation. Rawlins & Mansingh (1987) estimated this loss to be US$62 million per year (Commonwealth Caribbean only).

Green plants tend to produce secondary compounds which reduce or prevent grazing by insects (Fraenkel 1959, Whittaker & Feeny 1971, Levin 1976, Harborne 1977, Rosenthal & Janzen 1979). It is well established that some of these secondary compounds are toxic to insects and could be used as insecticides, antifeedants etc. (Ali et al. 1985, Ahmed & Grainge 1985). Similarly, marine plants (algae) are known to produce secondary metabolites which function as predator defense (Paul & Fenical 1982, 1986, Whylie & Paul 1989, Bakus 1981, Coll et al. 1982, Gerhart 1984, La Barre et al. 1986, Pawlirk et al. 1987). However, their acaricidal potential is unknown.

Beaver (1975) revealed that extracts from some terrestrial plants which are insecticidal are usually toxic to fishes. Similarly, extracts from various species of marine algae from the genus *Laurencia* are toxic to various fishes (Minott 1988, Minott & Pascoe 1987). These algae are rarely grazed by marine fishes. Their extracts may contain compounds which are insecticidal. Ticks and insects are closely related physiologically (Telfer 1965), thus toxins affecting insects may affect ticks also. The above relations form the basis of the present investigations.

MATERIALS AND METHODS

Algae known to yield extracts toxic to fishes (i.e. *Laurencia* spp.) as well as algae which are not grazed by fishes and are not heavily calcified (i.e. *Liagora* spp.) were selected for investigation.

Extraction

Algae were collected from the sea at Discovery Bay Marine Laboratory (in the parish of St. Ann, Jamaica), washed with distilled water, and allowed to drip-dry. Samples weighing 20g were then chopped into small pieces with the laboratory blender and extracted with 200ml of 95% ethanol for five days at 30 ± 3°C and 60-70% RH.

Extracts were decanted from residues and ethanol evaporated to dryness and a 10% (w/v) concentrate in acetone prepared fro acaricidal testing.

Test Tick

Fully engorged adult female *Boophilus microplus* (Canesterini) weighing between 150-180mg were selected for bioassay. This species of hard tick has developed significantly high levels of resistance to acaricides and is of economic importance, Rawlins & Mansingh (1987).

Bioassay

Thirty ticks in three replicates of ten were used for each extract. Ten ul (1 ug) of extracts were topically applied to the dorsum of ticks using a Hamilton micro-applicator. The controls were treated with 10 ul of acetone only.

Treated and control ticks were kept at 27°C and 60-70% RH in covered petri dishes and allowed to lay eggs until dead. Ticks were classified as dead if they failed to show appendicular responses and failed to produce eggs. Adult mortality after 96 h was recorded. The mean weight of egg masses were determined for each treatment after 12 days.

Eggs were placed in test tubes which were plugged with moistened cotton wool. Cotton wool was moistened every other day or as required to maintain a 80-90% RH to aid hatching of eggs.

After the eggs hatched three sub samples of 100-150 egg shells were collected from each test tube and the percentage of unhatched eggs and egg shells determined. From these data the inhibition of hatching and of reproductive potential were determined as shown below:

1. % Inhibition of oviposition =

$$\frac{\text{Mean wt of control eggs minus mean wt. of treated eggs}}{\text{Mean wt. of control eggs}} \times 100$$

2. % Inhibition of hatching = % of unhatched eggs in treated minus % of unhatched eggs in control.

3. Inhibition of reproductive potential =

$$\frac{\text{Inhibition of oviposition x Inhibition of hatching}}{100}$$

Mean percentages were separated using a One Way Analysis of Variance (ANOVA) followed by Student Newman-Keuls Multiple range test ($\alpha = 0.05$). All mean percentages were transformed to their respective Arc-Sine values before ANOVA was done (Zar 1974).

RESULTS AND DISCUSSION

Table 1 presents results on the biological effects of extracts on *B. microplus*. The data revealed that the extract obtained from *Laurencia obtusa* was the most toxic to *B. microplus* (comparing adult mortality). The *L. obtusa* extract was 4.0 times more effective in killing adult *B. microplus* than the extracts obtained from *Liagora farinosa*, *Padina vickerisiae*, and *Stypopodium lobatum*. However, the extract obtained from *L. obtusa* was not significantly more toxic than the extract from *Liagora elongata* (Table 1).

These findings suggest that the active principles of the extracts may have different modes of action on *B. microplus*. The ability of extracts to inhibit oviposition in ticks could be attributed to the inhibition of nervous mechanism involved in the release of the developed oocytes from the ovaries, as revealed by Stendel & Andrews (1973).

The overall effects of the extracts in reducing the reproductive potential of ticks are also presented in Table 1. The order of extracts in inhibiting the reproductive potential in *B. microplus* was *Laurencia obtusa* > *Stypopodium lobatum* > *Liagora farinosa* > *Padina vickerisiae* > *Liagora elongata*.

Rawlins (1977) reported the following 96 h mortality data for adult *B. microplus* treated with some acaricides; Carbaryl (0.0%), lindane (12.0%), chlorodimeform (0.0%), dioxathion (0.05%), naled (20.35%) and fenitrothion (0.0%), all tested at 1.0 ug/tick. The

TABLE 1. ACARICIDAL EFFECTS OF FIVE MARINE ALGAE EXTRACTS ON *B. MICROPLUS*.

Marine algae	96 hour mean adult mortality ± S.E.	Mean egg wt. (mg) + S.E.	Mean ± S.E. inhibition of:[1]		
			oviposition	Hatching	Reproductive potential
Laurencia obtusa	46.30a ±2.3	36.80a ±1.02	59.11a ±3.43	59.23a ±1.5	36.25a ±0.8
Liagora elongata	36.00a ±0.8	57.59b ±2.56	36.01b ±0.9	11.21b ±0.42	4.04b ±1.0
Liagora farinosa	16.00b ±0.91	68.55c ±0.98	23.83bc ±2.5	38.75c ±2.0	9.23bc ±0.6
Padina vickerisiae	16.00b ±0.4	59.78bc ±4.52	33.58c ±0.70	14.01b ±1.5	4.70b ±0.01
Stypopodium lobatum	16.00b ±1.4	36.80a ±3.20	59.11a ±0.25	34.41c ±0.8	20.34c ±1.5
Control	6.00c ±.3	90.05d ±4.36	–	–	–

[1] Means in a column with same letters are not significantly different from each other (S.N.T. $P<0.05$).

extracts from *Laurencia obtusa* and *Liagora elongata* were more active than these acaricides, causing 40.3% and 30.0% mortality respectively.

The present paper provides data supporting the potential of marine algae extracts as sources of effective natural product acaricides.

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COMPARISON OF FIELD OBSERVATIONS AND TRAPPING OF PAPAYA FRUIT FLY IN PAPAYA PLANTINGS IN CENTRAL AMERICA AND FLORIDA

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ABSTRACT

Papaya fruit flies, *Toxotrypana curvicauda* Gerstaecker, were observed on papaya trees in Guatemala and Costa Rica to compare with reported patterns of behavior for papaya fruit flies in south Florida. In both cases, males and females were nearly always on fruit and not on leaves. General activity of both sexes and female oviposition were highest in the morning in Central America, contrasting with the late afternoon activity period in Florida. A total of 23 mating pairs was observed in Costa Rica, all on papaya trees in late morning, compared to late afternoon to dusk in Florida. A fruit model trap baited with the pheromone 2-methyl-6-vinylpyrazine caught significant numbers of both male and female *T. curvicauda* in Costa Rica at a pheromone release rate of 1 μg/h. At this location, counts of flies in plots on papaya trees versus traps indicated a high rate of capture of both sexes of papaya fruit flies with the fruit-model sex pheromone trap.

RESUMEN

Se observo el comportamiento de las moscas *Toxotrypana curvicauda* Gerstaecker de la fruta en plantas de papaya en Guatemala y Costa Rica y se comparo dicho comportamiento con el observado en moscas de papaya en Florida. En ambos casos, los machos y las hembras fueron observados casi siempre en las frutas y no en las hojas. La actividad