

Biological activity of the secretion of *Edessa rufomarginata*, a Neotropical Pentatomid

Jerome J. Howard

Program in Evolutionary Ecology and Behavior, Department of Biology University of Iowa, Iowa City, Iowa 52242 U.S.A.

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Resumen: Cinco componentes obtenidos a partir de la secreción defensiva de la *Edessa rufomarginata* (Hemiptera: Pentatomidae) han sido examinados en el laboratorio con el objeto de determinar sus efectos en los hábitos alimenticios de depredadores vertebrados e invertebrados. Dichos componentes repelieron hormigas, pero ninguno evitó la acción depredadora de sapos y lagartijas, y sólo uno de ellos fue efectivo contra las ratas. Es posible que otros componentes de dicha secreción pueden defender a la *E. rufomarginata* de algunos vertebrados.

The defensive glands of the large Central American pentatomid *Edessa rufomarginata* (De Geer) (Hemiptera: Pentatomidae) secrete five lipid compounds which presumably defend the insects from predators (Howard and Wiemer 1983). Several of these compounds have been shown to penetrate the insect cuticle, and to cause paralysis of potential invertebrate predators (Remold 1963). However, less attention has been devoted to the effects of simple lipid secretions on potential vertebrate predators. Numerous vertebrates in lowland Costa Rica are significant predators of insects (Janzen 1983), and defensive secretions with broad deterrent or repellent activity against both vertebrates and invertebrates would be of undoubted value to *E. rufomarginata*. Here I report the effects of the five lipids known from the secretion of *E. rufomarginata* on the feeding of vertebrates and invertebrates in the laboratory, and the presence in this secretion of an additional component, as yet unidentified but thought to be a quinone.

Laboratory bioassays were conducted using pure decane, undecane, tridecane, E-2-octenal, and E-2-octenyl acetate, and a mixture of these in the 4:57:2:16:21 ratio in which they occur in the secretion of *E. rufomarginata*

(Howard and Wiemer 1983). Pure compounds were obtained from commercial sources (decane, undecane, and tridecane from Aldrich Chemicals; E-2-octenal from Alsa Products), with the exception of E-2-octenyl acetate. E-2-octenyl acetate was synthesized from E-2-octenol by treatment with acetic anhydride and pyridine. Toads (*Bufo marinus*), lizards (*Anolis carolinensis*), and rats (*Rattus norvegicus*) were used to investigate the effects of components on vertebrates, and ants (*Pheidole dentata*) were used to investigate effects on invertebrates. Two criteria were established *a priori* as signifying feeding deterrent activity of a test substance: refusal of food items coated with test chemicals when control food items were accepted; and observable behaviors indicative of distaste such as grooming or rubbing of mouthparts, and spitting out an ingested food item.

Toads were presented with 5th instar mealworms (*Tenebrio molitor*, 170 ± 12 mg) which were coated with 5 microliters of chemical (test) or left uncoated (control). Test and control mealworms were alternately presented for half an hour, and were replaced as they were consumed, or after 5 minutes. Mealworms which were not taken after 5 minutes were

TABLE 1

Effect of components of the secretion of Edessa rufomarginata on feeding behavior of the ant, Pheidole dentata. The numbers of ants visiting test and control baits are significantly different for each component tested ($P < 0.0001$, T test)

Component	Mean number of ants visiting baits	
	Control baits (N = 16)	Test baits (N = 16)
Decane	33.38 ± 9.07	9.81 ± 10.36
Undecane	40.06 ± 5.55	3.31 ± 5.24
Tridecane	40.25 ± 9.01	4.75 ± 8.39
E-2-Octenal	27.88 ± 7.96	0.06 ± 0.25
E-2-Octenyl Acetate	19.88 ± 5.10	0.00
Mixture	36.69 ± 3.74	1.13 ± 1.26

scored as rejected. Lizards were tested in a 40 liter aquarium in which 10 control and 10 test mealworms (2nd and 3rd instars, 55 ± 17 mg) were placed in small petri dishes in a randomized array. Test mealworms were coated with 2.5 microliters of the test substance, and the number of control and test mealworms eaten during one half hour were recorded. Rats were tested by offering them peanut halves (349 ± 49 mg), with test halves coated with 5 microliters of the test chemical. Tests were conducted on a total of four toads and lizards, and six rats. Two ant colonies were tested by placing four cubes of Bhatkar's artificial diet (Bhatkar and Whitcomb 1970) (189 ± 19 mg) on a tile square and coating two cubes with 5 microliters each of the test chemical. The number of ants surrounding each cube was recorded at 5, 10, 15 and 30 minutes after initiation of the test, and behaviors were observed with the aid of a binocular dissecting microscope.

Neither toads nor lizards showed any reaction to the test chemicals or mixture. All items offered were readily accepted, and no behaviors indicative of distaste were observed. Four of the six rats refused test peanut halves coated with E-2-octenal, but peanut halves coated with all other chemicals were accepted. Two rats initially accepted peanut halves treated with E-2-octenal, but dropped them within 30 seconds without chewing. After dropping the peanut halves, rats vigorously groomed the fur around the mouth, rubbed the mouth along the substrate, and refused additional peanuts for an average of 17.5 minutes.

Ants were actively repelled by all chemicals and the mixture (Table 1). Ants which approached cubes treated with chemicals immediately backed away while grooming the antennae and mouthparts.

With the exception of E-2-octenal, which constitutes less than 20% of the secretion, the substances tested failed to deter feeding by vertebrates, although all repelled invertebrates. Some evidence exists that other components may exist in the secretion of *E. rufomarginata*, and that these might be effective defenses against vertebrate predators. In the course of collecting insects for further study it was noted that the secretion of live *E. rufomarginata* causes a dark brown discoloration of the skin. This discoloration is in every way identical to that produced by exposure of skin to quinones. Quinones are highly reactive compounds, and are unlikely to have remained intact during the three to four weeks between the collection and the analysis of *E. rufomarginata* secretions by Howard and Wiemer (1983). Given the general irritant and deterrent properties of quinones (Eisner 1970), it is reasonable to conjecture that *E. rufomarginata* possesses a defensive system containing both lipids repellent to invertebrates and quinones which may be repellent to both vertebrates and invertebrates.

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