Defensive Strategies of Sponges

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Ribeiro S, Cassiano K, Cavalcanti D, Teixeira V, and Pereira R. 2012. Isolated and synergistic effects of chemical and structural defenses of two species of *Tethya* (Porifera: Demospongiae). Journal of Sea Research 68: 57-62.

Organisms employ a range of defenses to deter predation or injury. Such defenses can include chemical compounds or physical structures that are either produced by the organism or acquired from its environment. The use of one or a combination of chemical and physical defenses is especially common in sessile organisms such as plants, corals, and some sponges. Although chemical defenses are widespread in sponges, their variable expression within species and even within individuals across time and space has clouded an understanding of their effectiveness. Likewise, the role in defense of physical structures like sclerites and spicules, which also contribute to body structure, is uncertain because some studies have found an effect of their presence on consumption by predators while others have found no effect (Jones et al. 2005).

Ribeiro et al. (2012) investigated the use of chemical and physical defenses by Brazilian *Tethya* species to clarify the importance of the two predator deterrence strategies and their taxon specificity. While some sponge species have both chemical and physical defenses, relatively little is known about how the two act in concert. By testing for both species the feeding deterrence of each defense independently and in combination, they evaluated the effectiveness of different strategies to deter predation as well as whether the strategies could be used to diagnose taxonomic identity for a given individual.

Individuals of *Tethya maza* and *Tethya rubra* were collected from the intertidal for feeding trials. Hermit crabs (*Calcinus tibicen*), which normally do not prey on *Tethya*, were used as predators in order to evaluate feeding deterrence using predators that had no specific adaptations to the sponge's defensive strategies. After collection, chemical components and spicules were extracted from the sponges. Baits used in feeding experiments were made from carrageen, distilled water, and powdered squid with the chemical or spicules added. Amounts added to the food were based on concentrations of chemicals and spicules found naturally in the sponges, except for the spicule concentration of *T. rubra,* which was reduced by 2/3 due to difficulties in making the food. Each sponge species was used for baits that were fed to *C. tibicen* in one of three treatments—spicules, crude extracts, and spicules plus extracts—with each paired with a control that lacked extracts. The percentage of bait consumed was compared between treatments and between species. Chemical components of the species' defenses were also identified and compared to determine if species with similar chemical defenses are responded to similarly by predators.

Ribeiro et al. (2012) found a decrease relative to controls in the consumption of both sponge species (Figure 1). Chemical defenses alone were found to significantly reduce feeding for *T. maza*, and spicules alone were significant deterrents for both species. They further examined whether the two defenses showed (1) redundant effects, such that the combined effect was no greater than individual effects, (2) additive effects, such that the combined effect was the sum of single effects, or (3) a synergistic interaction, such that the combined effect was greater than the sum of the single effects. They found that the combination of chemicals and spicules was redundant in both species. Although a 10% further reduction in feeding on *T. rubra* occurred when comparing just spicules to spicules with crude extract, the difference was not significant. Overall, chemical and physical defenses of *T. maza* and *T. rubra* were similar given that reductions in amount of food consumed occurred for all treatments, but differences were found between species in the concentration of spicules and crude extract compounds as well as the effectiveness of these defenses in reducing predation. The fact that *T. maza* had a greater concentration and effectiveness of defenses than *T. rubra* was hypothesized to be related to *T. maza* living in a tidal zone where changes in tide level and predation co-occur, requiring a stronger defense than is needed for less exposed species such as *T. rubra.*

The identification of chemicals in the crude extracts found that *T. maza* and *T. rubra* both have seven sterols in similar concentrations. However, because predators responded somewhat differently to the two species, the shared sterols could not be the only active compounds used for chemical defense. Further study could determine which other active ingredients could help to explain the differences in predation and the extent to which chemical defenses may be useful in identifying degrees of relatedness among species (Ribeiro et al.

2012). Determining the active component in *Tethya* chemical defenses and comparing it to other sponge species could help to establish relationships between sponge species and determine the possible origin and evolution of defensive strategies in sponges.

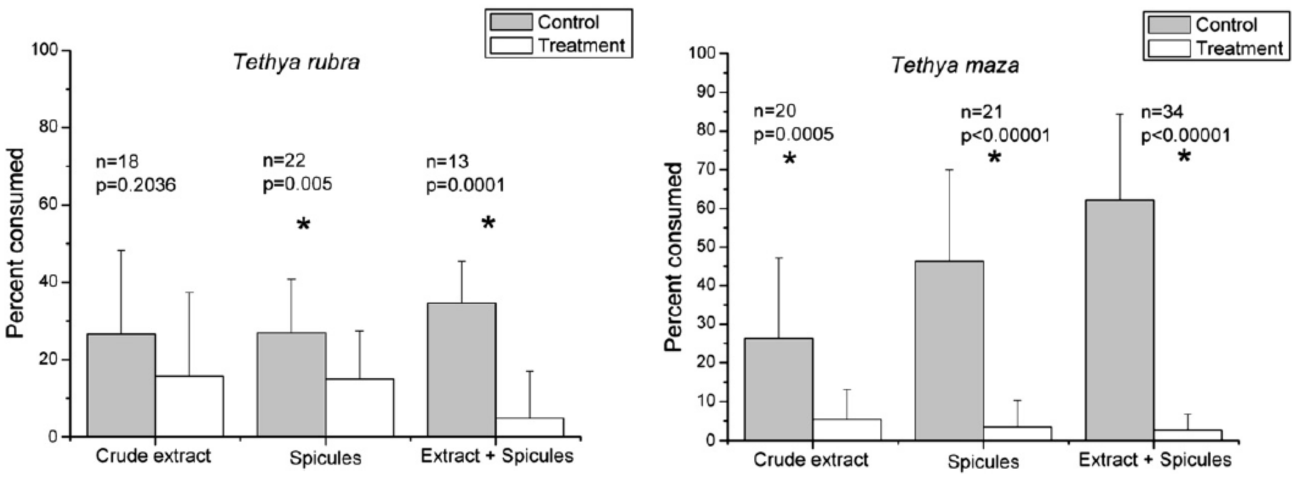

Figure 1. Percent of food consumed (mean ± SD) by *Calcinus tibicen* during control treatments (food without defensive components) and treatments with spicules, crude extract, or both. Significant difference between control and treatments is shown by asterisks.

Other Literature Cited

Jones A, Blum J, Pawlik J. 2005. Testing for defensive synergy in Caribbean sponges: bad taste or glass spicules? *Journal of Experimental Marine Biology and Ecology* 322: 67-81.