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Multifaceted roles of a termite queen pheromone

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Pheromones are likely involved in all social activities of social insects including foraging, sexual behavior, defense, nestmate recognition, and caste regulation. Regulation of the number of fertile queens requires communication between reproductive and non-reproductive individuals. Queen-produced pheromones have long been believed to be the main factor inhibiting the differentiation of new reproductive individuals. However, the active compounds of the inhibitory queen pheromone had not been identified in termites until recently. In 2010, we first identified n-butyl-n-butyrate and 2-methyl-1-butanol as the active components of the queen pheromone, which suppress the differentiation of new neotenic queens, in the termite *Reticulitermes speratus*. Identification of the chemical compounds made it possible to study various features of the queen pheromone. Interestingly, the same two volatiles are also emitted by eggs. This dual production of an inhibitory pheromone by female reproductives and eggs provides a mechanism ensuring honest signaling of reproductive status with a tight coupling between fertility and inhibitory power. Exposure to the pheromone resulted in a significant decrease in egg production by each queen, suggesting the role of queen pheromones as a signal regulating colony-level egg production in multiple queen colonies. In addition to the inhibitory functions, these volatiles also act as a promoter of the production of salivary lysozyme, which is an essential antibacterial agent in egg grooming by workers. Because the pheromone compounds suppress the growth of an egg-mimicking parasite fungus 'termite balls' and some entomopathogenic fungus, it is likely that the termite utilized antimicrobial volatiles for the defense of eggs and queens to function secondarily as a communication signal informing queen fertility. This is in line with the context of evolutionary parsimony that pheromones are originally utilized as defensive compounds and their communicative function is a secondary development.