Researchers discover ant rivals mix venom creating first instance of naturally occurring ionic liquid

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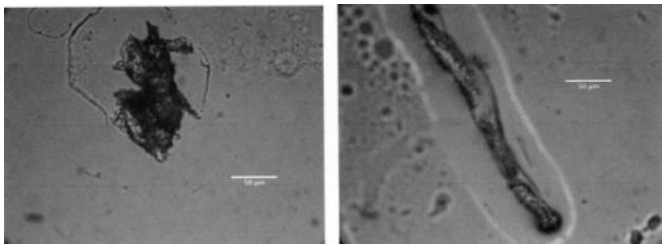

Micrographs of evaporates of alkaloid isolate (a) and fire ant venom (b) taken at a magnification of 50X. Credit: *Angew. Chem. Int. Ed.*. doi: 10.1002/anie.201404402

(Phys.org) —A large team of researchers with members from the U.S., China and France has found in studying the behavior of two types of invasive ant species in southern parts of the U.S., that ant venom is mixed when the two interact causing the creation of an ionic liquid material—the first known instance of such a material occurring naturally. In their paper published in *Angewandte Chemie International*, the team describes how the two species of ants interact and how the liquid material comes about.

When fire ants made their way into the U.S. several years ago it generated a lot of news, the name alone was enough to scare people unaccustomed to such a ferocious ant species. More recently, people who have come to accept the fire ants have learned that a new type of invasive ant (also from South America) has entered the area—tawny crazy ants. And they come with both good and bad news. The good news is they are displacing fire ants. The bad news is they're destructive and their populations swell rapidly. In this new effort the researchers have uncovered how it is that the tiny ants are able to overcome fire ants—when sprayed with fire ant venom, they cover themselves with their own venom rendering the fire ant venom harmless. But in so doing, they create a new type of thick material, an ionic liquid.

Ionic liquids are by definition, salt based with low melting points. Scientists have created a large number of such liquids over the years to serve a variety of purposes—they're used in batteries, solvents, sealants and electrolytes. The discovery by the researchers of an ionic liquid created in nature is the first that has been seen however, and thus it's generated considerable excitement in the chemistry community.

In studying the two ant species, the researchers found that when specimens encounter one another, the fire ant sprays the tawny crazy ant with venom, a move that kills many other types of insects. Instead of succumbing, the crazy ants immediately groom themselves with their own venom, rendering the fire ant venom harmless. Interestingly, another team of researchers also discovered the self-saving maneuver by the crazy ants—as part of an experiment, they found that if they prevented the crazy ants from grooming themselves, 48 percent of them died after being sprayed with fire ant venom. When allowed to groom, on the other hand, 98 percent survived. They've published their research in *Science Express*.

More information: Chen, L., Mullen, G. E., Le Roch, M., Cassity, C. G., Gouault, N., Fadamiro, H. Y., Barletta, R. E., O'Brien, R. A., Sykora, R. E., Stenson, A. C., West, K. N., Horne, H. E., Hendrich, J. M., Xiang, K. R. and Davis, J. H. (2014), On the Formation of a Protic Ionic Liquid in Nature. *Angew. Chem. Int. Ed.*. doi: 10.1002/anie.201404402

Abstract

The practical utility of ionic liquids (ILs) makes the absence (heretofore) of reported examples from nature quite puzzling, given the facility with which nature produces many other types of exotic but utilitarian substances. In that vein, we report here the identification and characterization of a naturally occurring protic IL. It can be formed during confrontations between the ants S. invicta and N. fulva. After being sprayed with alkaloid-based S. invicta venom, N. fulva detoxifies by grooming with its own venom, formic acid. The mixture is a viscous liquid manifestly different from either of the constituents. Further, we find that the change results as a consequence of formic acid protonation of the N centers of the S. invicta venom alkaloids. The resulting mixed-cation ammonium formate milieu has properties consistent with its classification as a protic IL.