

Single class of queen pheromones stops worker reproduction in ants, bees and wasps

January 16 2014

A new study by a team of KU Leuven and international researchers has found that the chemical structure of queen pheromones in wasps, ants and some bees is strikingly similar, even though these insects are separated by millions of years of evolution and each evolved eusociality independently of the other. The results suggest that queen pheromones used by divergent groups of social insects evolved from conserved signals of a common solitary ancestor.

Writing in the 17 January issue of *Science*, the researchers say the new insights "could contribute greatly to our understanding of the evolution of eusociality" in insects. Eusociality is characterised by cooperative brood care, overlapping adult generations and division of labour between fertile queens and sterile workers.

The researchers began by searching for sterility-inducing queen pheromones in representative species of wasps, bees, and ants. After identifying candidate queen pheromones by analysing chemical profiles of queens and workers, they created synthetic samples of the pheromones and tested them to see whether they inhibited worker reproduction.

They found that the synthetic odours mimicked the effect of the presence of a live queen in a nest – fewer workers' ovaries were activated and more regressed when exposed to the odour treatment than in non-odour controls.

The queen pheromones of all three species belonged to a single class of chemicals: saturated hydrocarbons. To further investigate their findings across a larger sample of social insect species, the researchers then conducted a systematic review of fertility- and queen-linked odours in 64 species using data from previously published studies. The findings matched up: saturated hydrocarbons were the single most common class of chemicals overproduced by queens or fertile individuals. From this, the researchers concluded that saturated hydrocarbons act as a conserved class of queen pheromones in ants, bees and wasps – a surprising finding because these insects started diverging some 145 million years ago and each evolved eusociality independently.

How to explain the chemo-structural similarity of queen pheromones across distantly related species? "Our thinking is that queen pheromones in [social insects](#) likely evolved from 'fertility cues' used by female individuals of solitary insect species. These cues were probably used to attract male mates," says corresponding author Tom Wenseleers. "That hypothesis is strengthened by the fact that some of the compounds we studied also function as mate attractants in solitary [insect species](#). And this ultimately supports the hypothesis that fertility signals, which eventually evolved to become queen pheromones that regulate reproduction, have remained the same since the last common solitary ancestor of all social insects, which lived approximately 145 million years ago," says Wenseleers.

More information: "Conserved Class of Queen Pheromones Stops Social Insect Workers from Reproducing," by A. Van Oystaeyen et al. *Science*, 2014.

Provided by KU Leuven

Citation: Single class of queen pheromones stops worker reproduction in ants, bees and wasps (2014, January 16) retrieved 6 May 2024 from <https://phys.org/news/2014-01-class-queen-pheromones-worker-reproduction.html>

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