The smell of attraction: cuticular hydrocarbon (CHC) profiles in a horned beetle

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INTRODUCTION

Males often compete with rival males for access to females. Sometimes this involves outright battle, leading to the evolution of elaborate horns, tusks, or antlers. In other species males compete indirectly, by displaying bright colors or singing elaborate songs to attract females. Occasionally, males have to do both: first they have to fight for control of a territory, and then, if they win, they have to court the females who visit, convincing them to mate.

In insects, male courtship can involve blends of attractive smells. Here I measured the chemical odors of rhinoceros beetles, to test whether males smell different from females, and whether aspects of male body size (dominance) or body condition are reflected in their odor profiles.

RHINO BEETLE BIOLOGY

Male *Trypoxylus dichotomus* wield a "pitchfork" horn on the front of their heads, which they use in battles with rival males over feeding territories (oozing sap) on the sides of trees. Large males with long horns win most of the fights, and victorious males encounter females as they feed on the sap. For many years this was considered to be the whole story. However, careful field observations showed that winning fights was not enough. Females often rejected the territorial male -- even if he was large and had a long horn. We now realize that males spend hours each night courting females, using trembling "dances", stridulatory "songs", and, we suspect, attractive blends of cuticular hydrocarbons (smells).

CONCLUSIONS

Rhino beetle CHC profiles contain meaningful information about the sex of the beetle and, for males, relative body size, which could be used as a signal by either females or rival males.

FUTURE DIRECTIONS

- Do females really choose mates based on CHC profile?
- How do CHC profiles change when nutrition is altered?
- How do females sense the male's CHC's during mating?

RESULTS

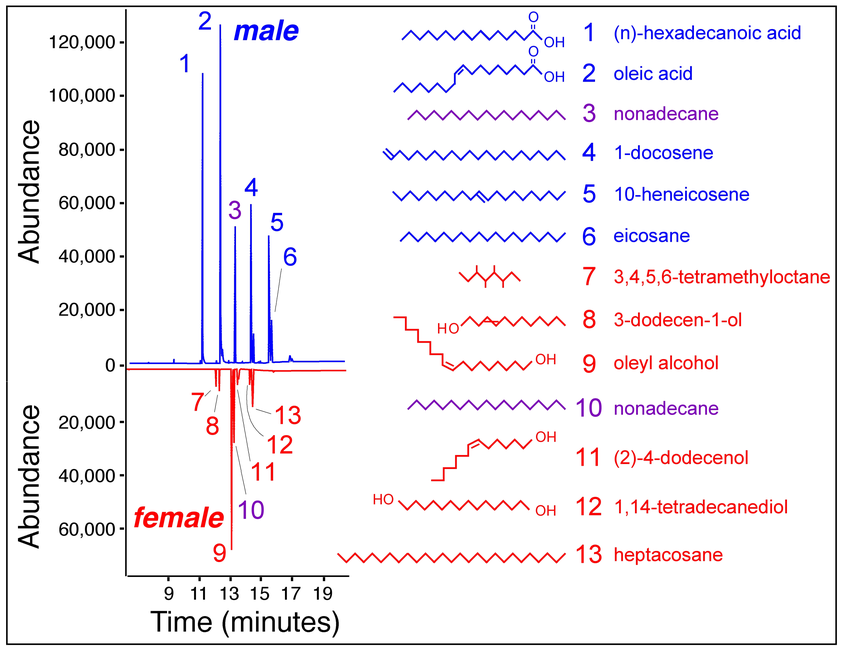

FIGURE 1. GC-MS peaks from one male and female specimen. The chemical identities of the peaks and the abundance of each chemical varies drastically between sexes.

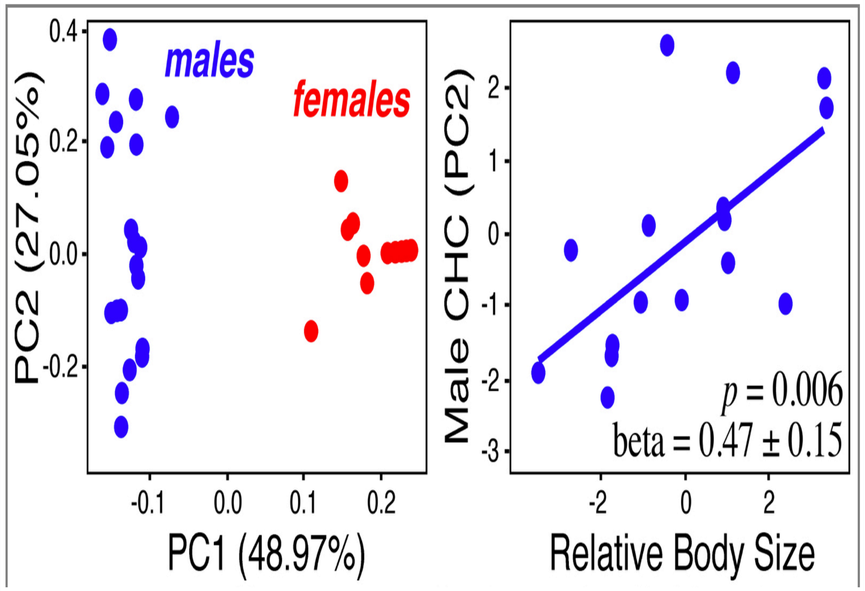

FIGURE 2. The CHC profiles seem to be sexually dimorphic. There is also individual variation among males that correlates with body size (long term condition).

ACKNOWLEDGEMENTS

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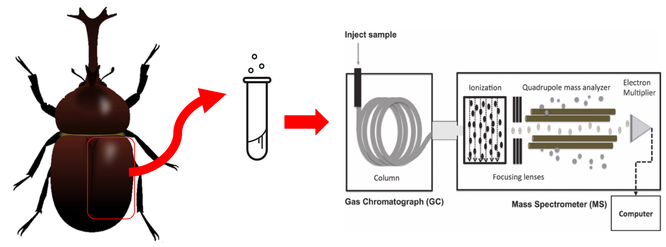
METHODS

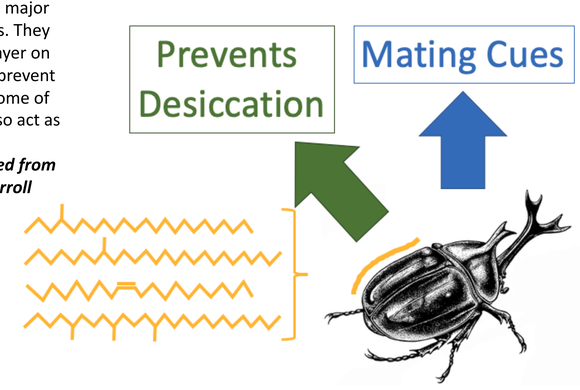
- ❑ Removed one elytra
- ❑ Soaked in 800 µL of hexane for 30 minutes
- ❑ Ran through GC-MS machine



WHAT ARE CUTICULAR HYDROCARBONS?

The outer layer of insect cuticle is covered with a thin coating of wax, comprised primarily of long-chain hydrocarbon molecules. Although all cuticular hydrocarbons have the same basic structure, a long backbone of carbons and hydrogens, they differ wildly in chain length. Insect cuticle is typically covered with a blend of different CHCs, and the specific molecules and their relative abundance can be highly sexually dimorphic, playing a role in mate signaling and species recognition. CHC's are costly and ephemeral, requiring steady production. For this reason, they can also serve as reliable signals of physiological condition and overall body size, and females often use CHC profiles to choose attractive, high quality males as mating partners.

CHCs play two major roles in insects. They form a waxy layer on the cuticle to prevent desiccation. Some of these CHCs also act as mating cues.
Figure modified from Chung and Carroll 2015



HOW DO INSECTS SMELL?

Antennae are packed with chemoreceptors that detect airborne odors, but insects can "taste" their surroundings too. Hairs lining mouthparts and even the pads of their feet have pores that detect chemicals, permitting them to sense the things they touch. It is hairs like this, along the face and feet, that probably allow female rhinoceros beetles to smell the "cuticular hydrocarbons" embedded in the outer layer of the male cuticle.