Synthesis of Isocoumarin Ant Trail Pheromones

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Introduction

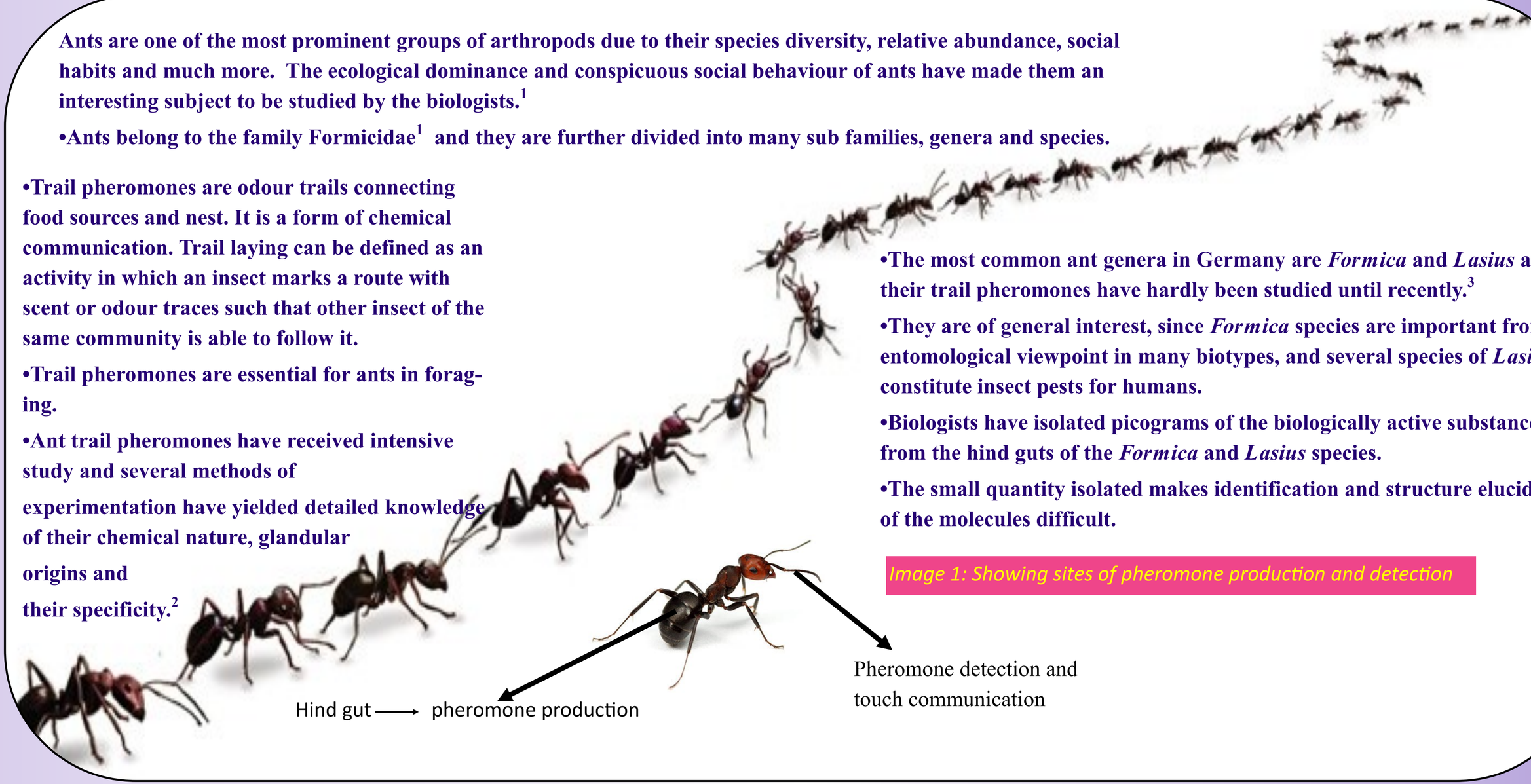
Ants are one of the most prominent groups of arthropods due to their species diversity, relative abundance, social habits and much more. The ecological dominance and conspicuous social behaviour of ants have made them an interesting subject to be studied by the biologists.[1]

•Ants belong to the family Formicidae[1] and they are further divided into many sub families, genera and species.

•Trail pheromones are odour trails connecting food sources and nest. It is a form of chemical communication. Trail laying can be defined as an activity in which an insect marks a route with scent or odour traces such that other insect of the same community is able to follow it.

•Trail pheromones are essential for ants in foraging.

•Ant trail pheromones have received intensive study and several methods of experimentation have yielded detailed knowledge of their chemical nature, glandular origins and their specificity.[2]



•The most common ant genera in Germany are *Formica* and *Lasius* and their trail pheromones have hardly been studied until recently.[3]

•They are of general interest, since *Formica* species are important from an entomological viewpoint in many biotypes, and several species of *Lasius* constitute insect pests for humans.

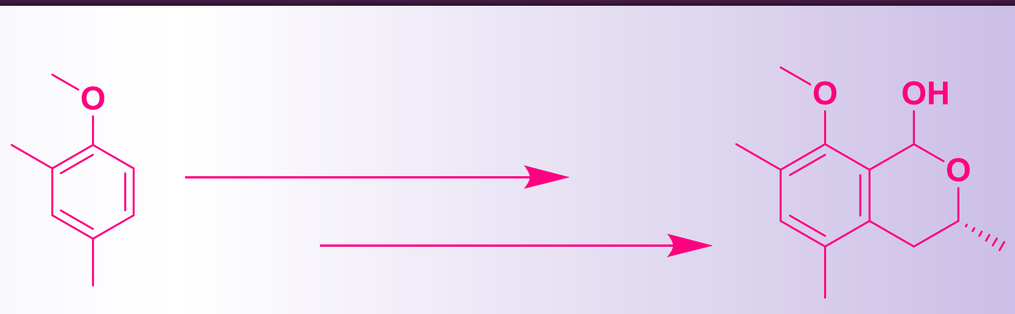
•Biologists have isolated picograms of the biologically active substance from the hind guts of the *Formica* and *Lasius* species.

•The small quantity isolated makes identification and structure elucidation of the molecules difficult.

Image 1: Showing sites of pheromone production and detection

AIM

- **Synthesise** • Chemically synthesise the biologically active substances using a multistep process.
- **Purify** • Purify crude products at each stage to remove regioisomers and by-products using column chromatography as the main tecnique.
- **Deliver** • Provide synthesised material for characterization, biological evaluation and comparison with natural products isolated from the species.

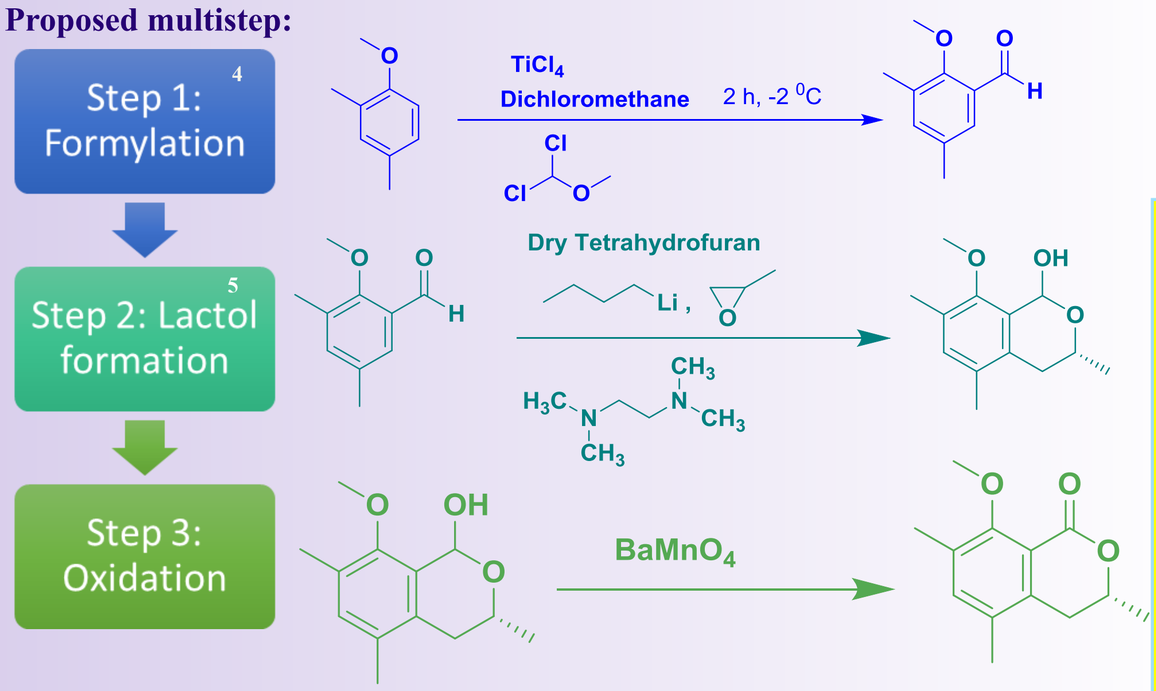


2,3-Dimethylanisole

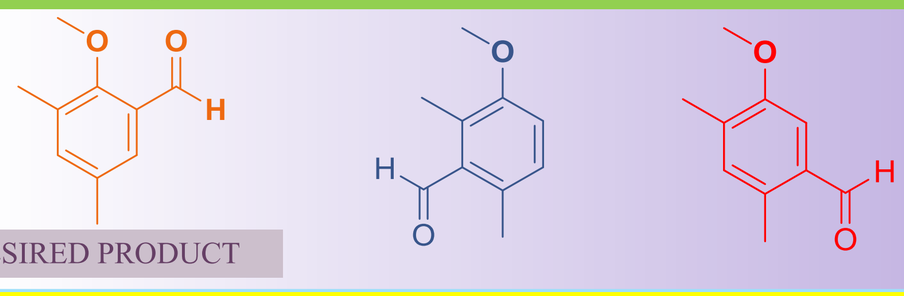
3,4-dihydro-8-hydroxy-3,5,7-trimethylisocoumarin

METHOD AND RESULTS

Proposed multistep:



Possible regioisomers:



DESIRED PRODUCT

- **Poor yield is due to formation of regioisomers.**
- **Regioisomers have similar polarities.**
- **Difficult to purify**
- **Column chromatography used for purification.**
- **Different solvent systems such as hexane: ethyl acetate, petroleum ether: diethyl ether, Toluene: diethyl ether were tried in varying ratios.**
- **Hexane: diethyl ether (9:1) was found to be the best system.**
- **Other fractions containing product were isolated but was impure**
- **Yield can be improved by further purification of the fractions containing a mixture of product and impurities.**
- **Pure product characterised using ^{1}H NMR, ^{13}C NMR, Infrared spectroscopy and Mass Spectrometry.**

Step 2 was attempted but wasn't completed successfully.

Conclusion

- To conclude, only step 1 was successfully completed. Even though the yield is low, the method is promising. Different purification systems could be tried for a better yield.
- Step 2 could have been reattempted if given more time.

References

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