Extraction and Transformation of Eugenol from Cloves

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Abstract

Eugenol is the essential oil that is extracted from cloves, a household spice that is created from dried flowers of the clove tree. Eugenol was extracted from cloves using fermentation and a rotary evaporator, then transformed into methyleugenol by the Purdie methylation. An Infrared Spectroscopy spectrum was then taken of the extracted Eugenol and methyleugenol to confirm the identity of the molecules.

Introduction

This experiment was modeled after an ACS experiment done in 2000 with tea tree oil. The same extraction was done using fermentation and a rotary evaporator [1]. To confirm the results, IR is used which analyses the molecule by passing infrared radiation over a range of frequencies through the sample and measuring absorptions of each type of bond. After the extraction, eugenol was then transformed with another ACS experiment, the Purdie methylation, which is shown in figure 1 [2].

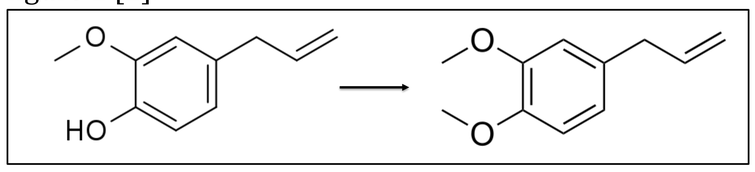

Figure 1. The Purdie methylation on eugenol. The alcohol gets deprotonated, and a methyl group is added onto the oxygen to create an ether.

Materials and Methods

Extraction

- Fermented cloves with ethanol for five days.
- Rotary Evaporator for 20 minutes to remove ethanol.

Transformation

- Purdie methylation using silver oxide and iodomethane with 2 hour reflux [2].

Figure 2. Model of a Rotary Evaporator.

IR Spectrum of Experimental Eugenol

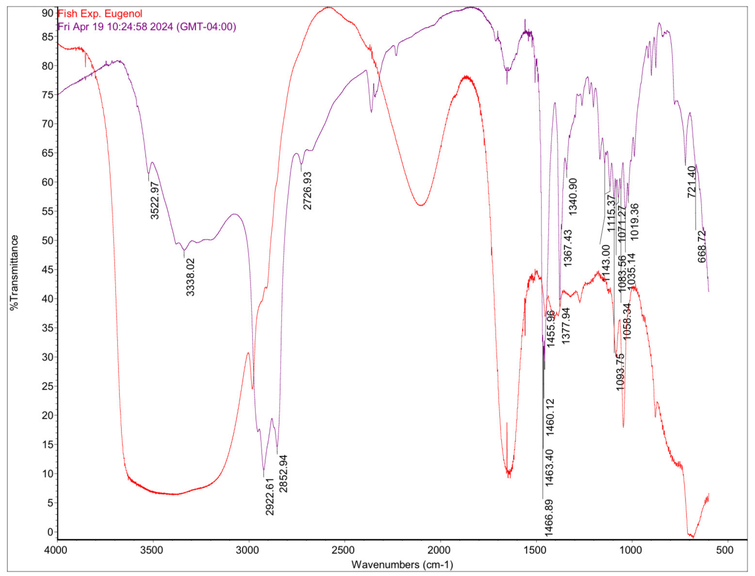

Figure 3. IR spectrum of extracted eugenol. Alcohol stretching is seen around 3500 cm^{-1} and carbon hydrogen stretching is found around 2900 cm^{-1}.

IR Spectrum of Methyleugenol

Figure 4. IR spectrum of methyleugenol after Purdie methylation. There is no alcohol stretching, but the carbon hydrogen stretching is still found.

IR Spectrum of Theoretical Eugenol

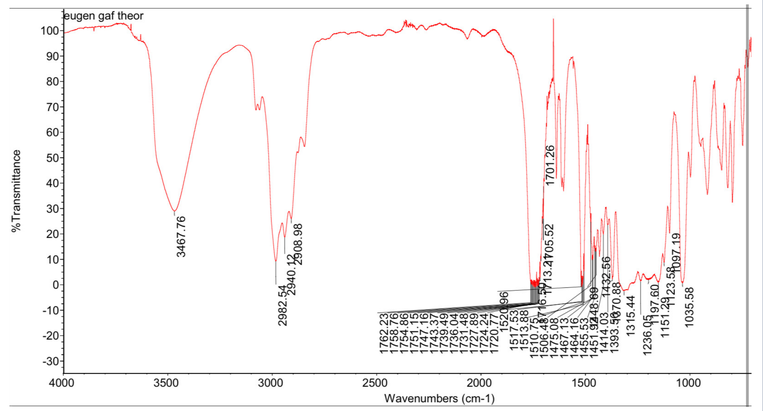

Figure 5. IR spectrum of 99% eugenol. Alcohol stretching is seen around 3500 cm^{-1} and carbon hydrogen stretching is found around 2900 cm^{-1}.

Discussion

Conclusions

- Eugenol was successfully extracted from cloves as shown by the experimental vs theoretical IR spectrum.
- Eugenol was also successfully transformed into methyleugenol using the Purdie methylation method. This was seen by losing an alcohol group and gaining an ether group.

Future Testing

- Run mass spectrometer samples to confirm the structure of eugenol and methyleugenol.
- Figure out how much product the Purdie methylation yields and if the method has high enough yields for industry scale production.

Literature Cited

[1] J. Agric. Food Chem. 2000, 48, 9, 4041–4043. Publication Date: August 31, 2000. https://doi.org/10.1021/jf0004356.

[2] J. Am. Chem. Soc. 1938, 60, 10, 2563–2564. Publication Date: October 1, 1938. https://doi.org/10.1021/ja01277a504.

Acknowledgments

Thank you to Dr. Nicholson and the College of Arts and Sciences for the support and funding!