Authentication of Pharmaceuticals using the Rotation of Plane Polarized Light

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Objectives

•Synthesize an Isoleucine derivative.

•Formulate security ink compatible with synthesized compound.

•Print covert ink onto pharmaceuticals and detect rotation of plane polarized light.

Procedures

Synthesis of L-Isoleucine derivative
-The reaction scheme shown in Figure 2 was used to synthesize the L-Isoleucine derivative for deposition onto pharmaceuticals.

Testing solid chiral molecule rotation
-Using the arrangement shown in Figure 3, chiral molecules on a glass slide were tested for rotation of plane polarized light.

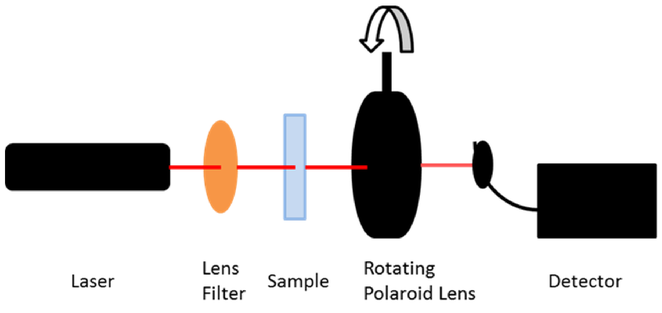
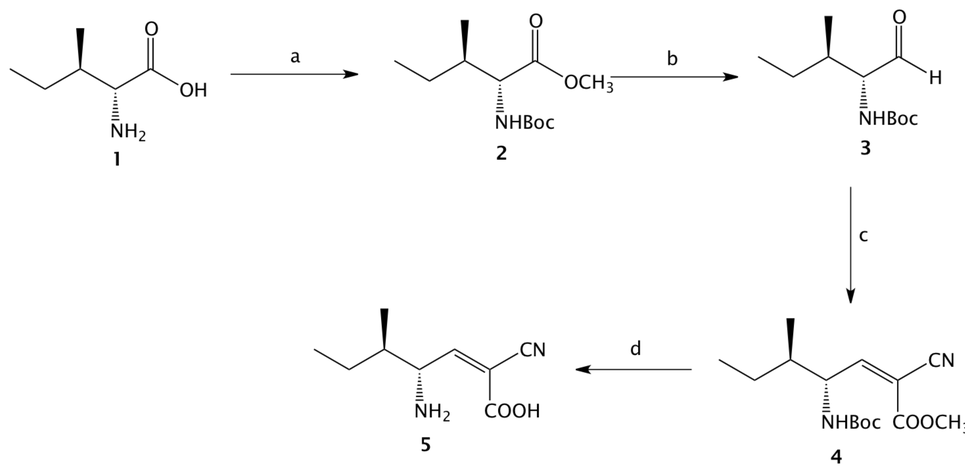


Figure 3: Light rotation detection apparatus.

Introduction

The introduction of counterfeit pharmaceuticals to the supply chain has become increasingly difficult to regulate. Experts estimate that 10% of worldwide pharmaceuticals are counterfeit, with 25% being counterfeit in developing countries. Detection of differences between authentic and counterfeit drugs can be nearly impossible as seen in Figure 1. Therefore, a method for the end user to authenticate pharmaceuticals is needed. With the ability to rotate plane polarized light, chiral molecules on pharmaceuticals would add another layer of authenticity.

Figure 1: An example of counterfeit Lipitor, left, next to authentic Lipitor, right.



Reagents and conditions: (a) (i) Acetyl chloride, MeOH, 0°C-rt, 24 h; (ii) $(Boc)_2O$, DCM, TEA, 0ºC-rt, 12 h; (b) DIBAL-H, THF, -78 ºC- rt, 2 h; (c) $CNCH_2COOCH_3$, piperidine, EtOH, reflux 2 h; (d) (i) 6 N HCl, MeOH, reflux for 12 h.

Figure 2: Reaction Scheme.

Results

- Step a of the reaction was completed with 20% yield. NMR of product shown in Figure 4.
- Rotation was unable to be detected from a thin layer of chiral L-Proline.

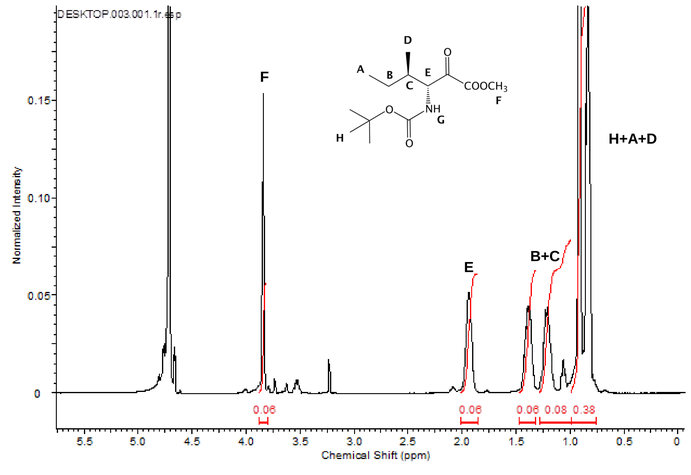


Figure 4: ^{1}H-NMR of step a product.

Conclusions

With the presence of counterfeit pharmaceuticals many methods of authentication will become important. Chiral molecules as a form of authentication provide a very unique possibility in this area and should be further explored. Many different molecules rotate light. Further research should be investigated to determine a good chiral molecule as well as exploring some of the issues, such as light scattering.

Future Work

•Complete the synthesis of the Isoleucine derivative.

•Develop a security ink containing chiral molecules.

•Print chiral ink onto pharmaceuticals and detect rotation.

Acknowledgements

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