Analysis of Tryptophan as a Non-toxic Ink for Covert Pharmaceutical Security Features

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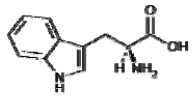
Introduction

Counterfeit Pharmaceuticals

- Any medications that do not contain the correct amount of active ingredient and can possibly contain harmful toxins.
- An estimated 10% of pharmaceuticals sold around the world are counterfeit.
- The only security features currently being used on tablets are overt.

Tryptophan

- Non-toxic amino acid.
- UV-UV fluorescence (Figure 3).
- Cost efficient.



Tryptophan

Research Objectives

- Develop a non-toxic dye with tryptophan that is able to be printed on the surface of tablets.
- Create a method for the easy detection of ultraviolet light emitted from tryptophan.
- Apply tryptophan onto surface of tablet and test method of tryptophan detection.

Figure 1: Excitation source used to capture images of tryptophan fluorescence.

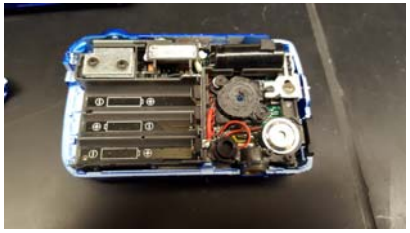


Figure 2: Vivitar Vivicam F126 with UV/IR filter removed in order to capture UV light.

Procedure

Ink Formulation

- Prepared 0.04 M potassium phosphate buffer (7.0 pH).
- Prepared 30 mM tryptophan solution in potassium buffer.
- Prepared 0.8 M sodium sulfite solution in water for blank (Figure 5).

Application & Imaging

- Applied 30 mM tryptophan solution to surface of glass coverslips, Equate Pain Reliever tablets, and Advil tablets with 50 µL capillary tube. Aided buffer evaporation by heating to 55°C.
- Samples illumination was performed using a Horiba Fluoromax 4 fluorometer (Figure 1), excitation light set to 305 nm with 5 nm slit, and fluorescence was photographed with a Vivitar Vivcam F126 camera with the UV/IR filter removed (Figure 2).

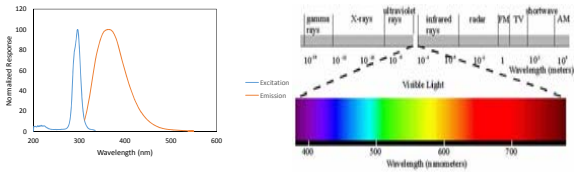


Figure 3: Fluorescence spectrum of 1 mM tryptophan solution in water (left). Light spectrum (right).

Figure 4: Coverslip spotted with 30 mM tryptophan solution. Taken with cell phone camera under ambient light (left). Taken with modified camera under 305 nm light (right).

Figure 5: Coverslip spotted with 0.8 M sodium sulfite (Na_2SO_3) in water for use as blank. Taken with cell phone under ambient light (left). Taken with modified camera under 305 nm light.

Results

- Fluorescence could be photographed on coverslips. (Figure 4).
- Ink was compatible with both tablets used. (Figures 6 & 7).
- Images of tryptophan able to be captured with specialized excitation source and emission capture device.

Figure 6: Equate Pain Reliever tablet spotted with 30 mM tryptophan solution. Taken with cell phone camera under ambient light (left). Taken with cell phone camera under 305 nm light (center). Taken with camera under 305 nm light (right).

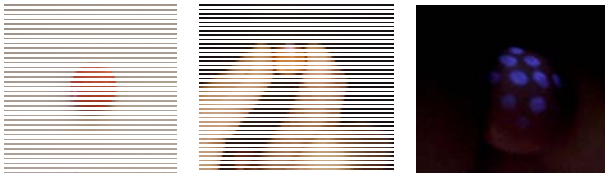


Figure 7: Advil spotted with 30 mM tryptophan solution. Taken with cell phone camera under ambient light (left). Taken with cell phone camera under 305 nm light (center). Taken with modified camera under 305 nm light (right).

Conclusions

- Security features printed with tryptophan ink could provide covert security to pharmaceutical tablets.

Future Work

- Print QR code onto the surface of tablet with tryptophan ink using microprinting.
- Assemble a cost-efficient excitation source.

Acknowledgments

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