

Pharmaceutical Forgeries: More Than Meets The Eye

Introduction

It's estimated that up to 10% of all drugs sold in the world may be counterfeit [1] and in some countries may be as high as 50% of drugs sold. For consumer safety, pharmaceutical brand prestige, and negative economic consequences, a chemical screening capability is needed to identify counterfeit pharmaceuticals, remove them from the supply chain, provide screening test data to forensic investigators, and evidence to convict the criminals involved. Counterfeit pharmaceuticals are fertile ground for crime; profits can be as high as illegal narcotics, the risk of being apprehended is lower, and with modern technology, it is not difficult to insert counterfeits into the supply chain.

IR spectroscopy is a primary laboratory method for analysis of pharmaceutical products [2]. Attenuated total reflection (ATR) is a powerful technique employed in laboratory based FT-IR spectrometers and may be used to analyze counterfeit pharmaceuticals due to the ease of sampling. Viagra[®], a drug to treat erectile dysfunction, is a commonly counterfeited product. In this example, Viagra[®] tablets were obtained over the internet for a fraction of the cost paid at a neighborhood pharmacy. Czitek's MicromATR Vision diamond ATR accessory was used to analyze an internet-sourced tablet and a known genuine Viagra[®] tablet. The chemical compositions of these tablets were then compared.

Results and Discussion

Fig. 1, right shows an image of a tablet purchased over the internet, while the left image is of a genuine Viagra[®] tablet. The color of the tablet purchased on-line is slightly different, the labeling on the tablets are not the same, and the shapes are slightly different.



Figure 1: (Left) Genuine Viagra[®] tablet; (Right) Viagra purchased online.

An IR spectroscopic chemical analysis of the tablet purchased on-line demonstrates the power and capability of IR spectroscopic methods to mitigate the counterfeit pharmaceutical problem. An advantage of the MicromATR single reflection diamond ATR is the ability to selectively analyze the outside coating of a tablet separately from the inside where the active pharmaceutical ingredient is contained. The chemical makeup of the coating can be definitive in identifying counterfeits.

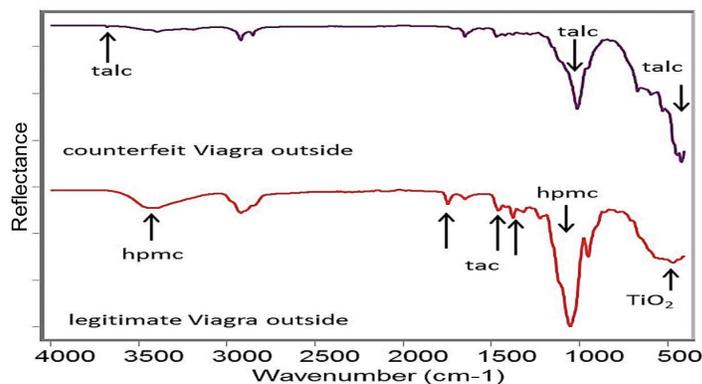


Figure 2: IR Spectra of the coating on the two tablets. (Top) Counterfeit in purple; (Bottom) Genuine Viagra[®] in red.

In Fig. 2 arrows indicate characteristic IR absorption bands of various constituents. The chemical constituents in the coatings are very different between the tablet purchased on-line and genuine Viagra®. The counterfeit Viagra® coating is dominated by the IR spectrum of Talc with weaker binder absorption features. The coating of genuine Viagra® contains detected constituents of hydroxypropyl methylcellulose (hpmc), triacetin (glycerin triacetate, tac), and titanium dioxide (TiO₂), a pigment.

The analysis of the inside of the tablets also indicates different chemical compositions. For comparison, an IR spectrum of Viagra® active ingredient, sildenafil citrate, is shown at the bottom of Fig. 3.

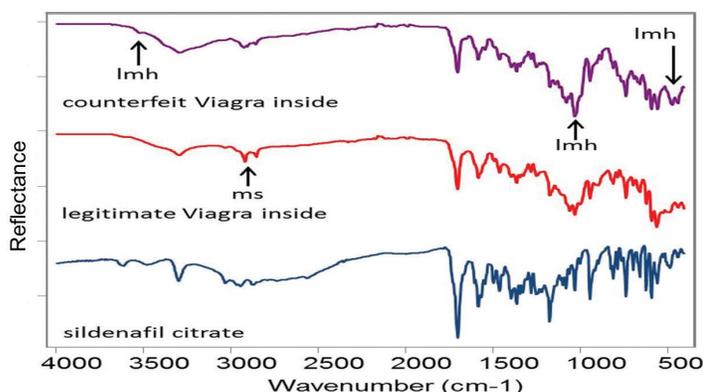


Figure 3: IR spectra of the inside of both the counterfeit (purple) and genuine (Red) Viagra® tablets. Additional IR spectrum of the active ingredient sildenafil citrate (Blue).

The Viagra® product contains the active ingredient and excipients present for various functions. One very important excipient function is enhancing or regulating bioavailability. Genuine Viagra® contains detected components of sildenafil citrate, microcrystalline cellulose, and methyl stearate (ms). The counterfeit tablet contained the active ingredient, sildenafil citrate; however, the excipient profile was different. Lactose monohydrate (lmh) was identified and methyl stearate was absent. This different excipient profile could affect the function and safety of this counterfeit pharmaceutical.

Conclusion

With the US alone reporting \$424.8 billion in pharmaceutical sales in 2015, the counterfeit market could be worth \$42 billion in the US alone [3]. As proven above in the detailed chemical makeup of both the counterfeit and genuine Viagra® tablets, the MicromATR provides an ergonomic tool to analyze both the inside and outside of potential counterfeit tablets. Subtle differences in the excipient composition could be difficult to detect where analyzing the outside of the tablet proved to be very useful in identifying the counterfeit tablet

References:

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3. Pharmaceutical Commerce. "IMS 2015 Use of Medicines report: US sales reach \$424.8 billion." 14 Apr. 2016. <http://pharmaceuticalcommerce.com/business-and-finance/ims-2015-use-medicines-report-us-sales-reach-424-8-billion>