Identification of counterfeit tobacco using Fourier transform infrared spectroscopy

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Introduction

Counterfeit tobacco can be encountered across the supply chain. Toxins encountered in tobacco can range from sugars to highly toxic organic material. This stimulates the need for development of rapid methods for identification of counterfeit tobacco. Attenuated total reflectance-Fourier transform infrared (ATR-FTIR) spectroscopy is a rapid technique that can identify the minimum amount of sample (few mgs) in a short time.

This work aims at development of an ATR-FTIR method for identification of fake tobacco.

Experimental

Sixteen authentic and five counterfeit tobacco products were used. Pure substances of common impurities were measured) using the Bruker mobile IR spectrometer equipped with a diamond ATR crystal.

Figure 1. ATR-FTIR spectra of (a) ammonium hydroxide, (b) caffeine, (c) formic acid, (d) glucose, (e) isopropanol, (f) lactose, (g) nicotine, (h) resorcinol, (i) rutin and (j) sucrose measured using the Bruker mobile IR equipped with ATR diamond.

Results and Discussion

The ATR-FTIR spectrum of each substance represented characteristic peaks that corresponded to the chemical structure and properties of this substances (Figure 1).
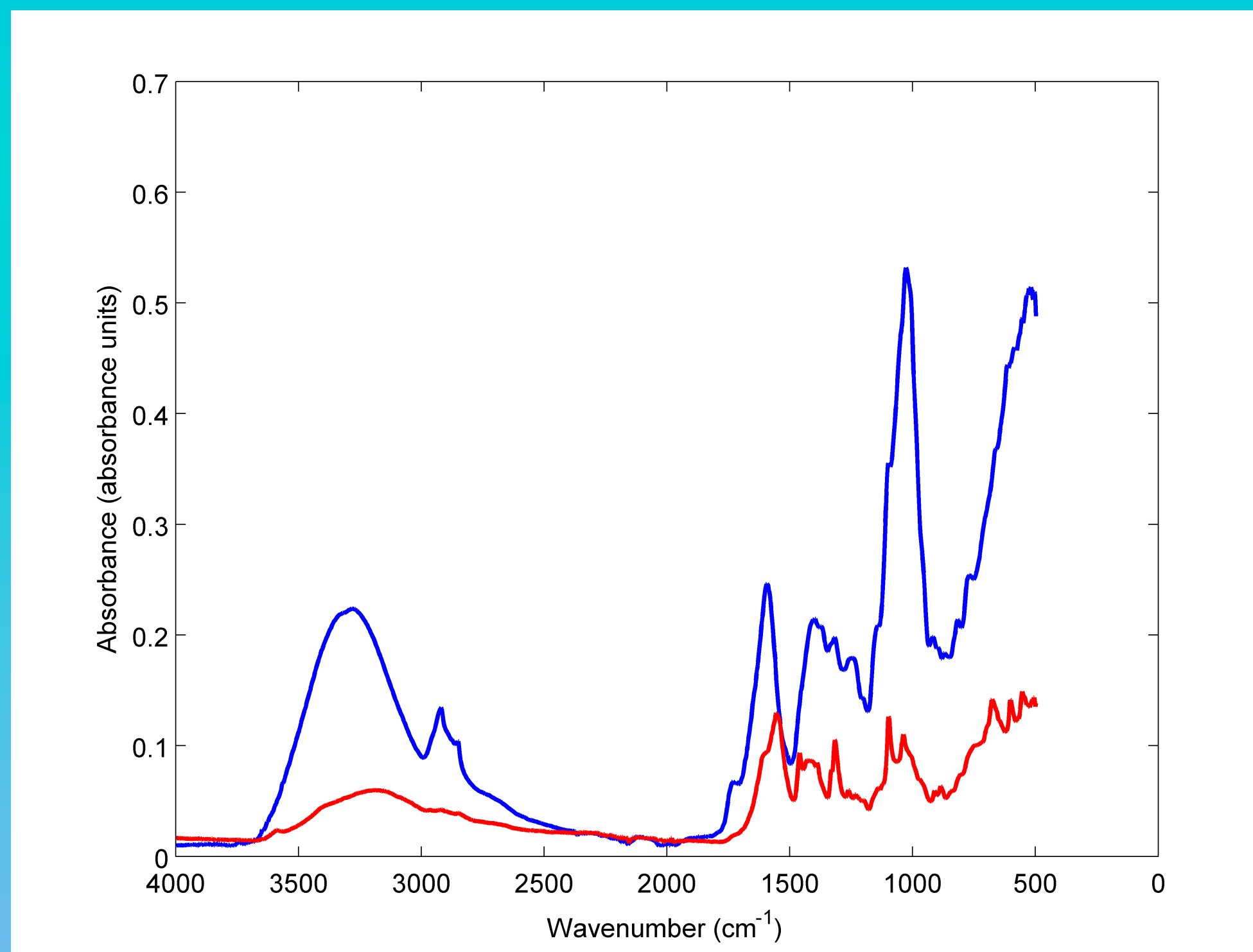

Figure 2. ATR-FTIR spectra of authentic (blue) and counterfeit (red) tobacco measured using the Bruker mobile-IR equipped with ATR diamond.

Authentic versus counterfeit tobacco

The organic composition of the authentic and counterfeit showed high similarity in relation to the chemical groups. However, counterfeit tobacco batches showed lower absorbance intensity (Figure 2).

Moreover, when CWS method was applied to the authentic and counterfeit batches, counterfeit tobacco batches gave false positive results (r values > 0.95). Similarly, PCA showed no precision among the scores of two counterfeit batches.

On the other hand, cluster analysis was able to discriminate the authentic from the counterfeit batches with high accuracy and precision (Figure 3).
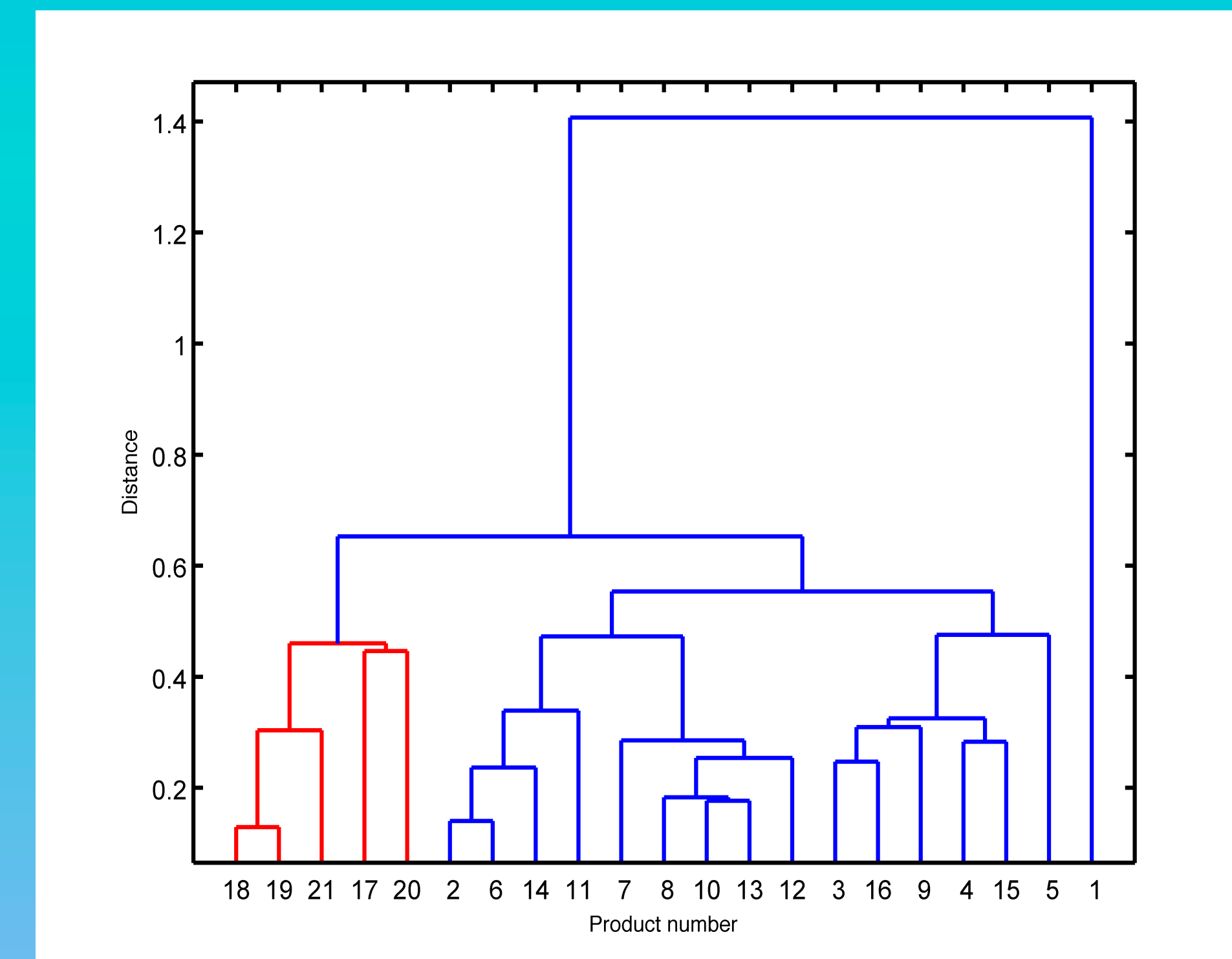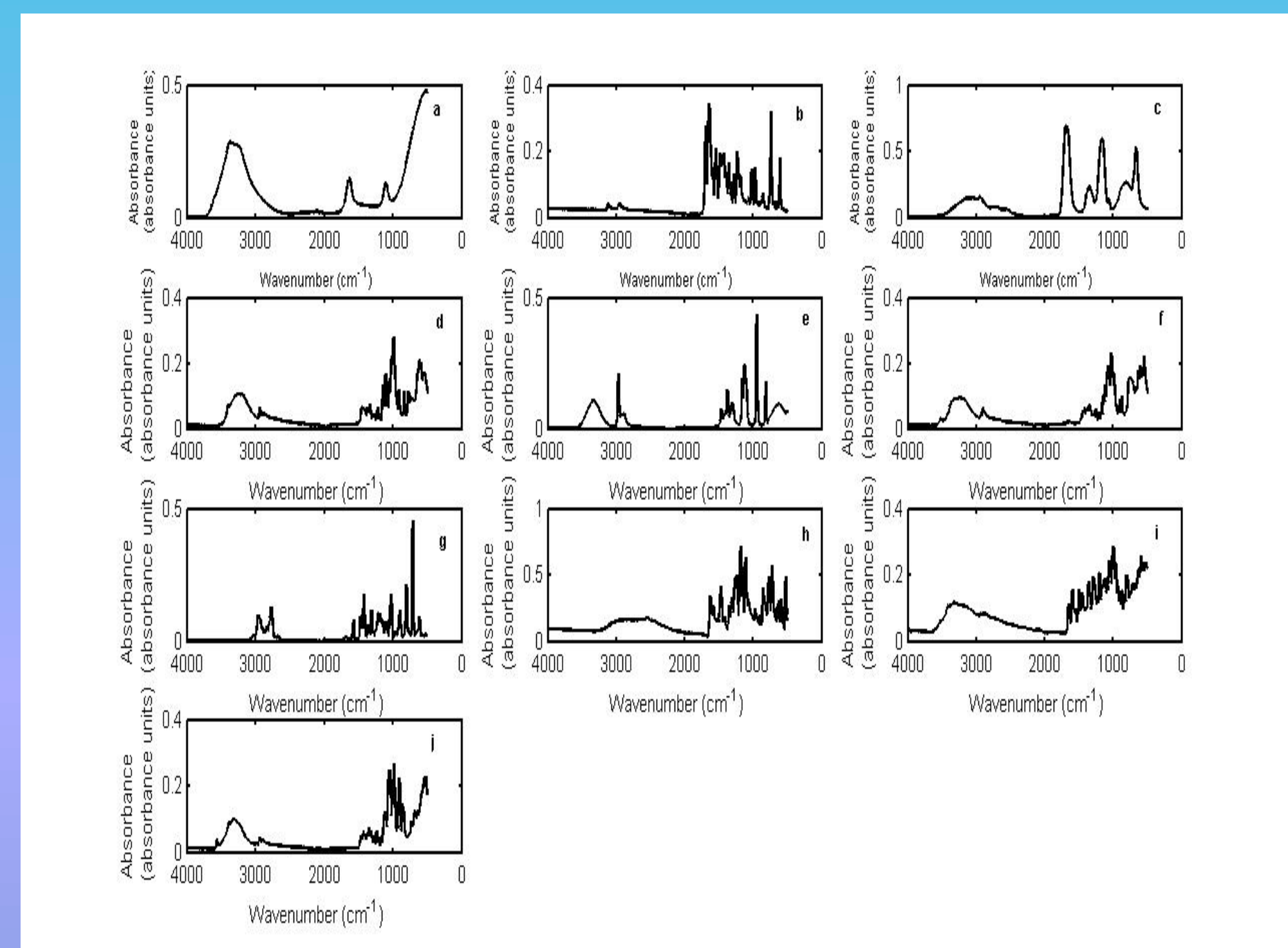

Figure 3. Distance plot of authentic (blue) and counterfeit (red) tobacco batches measured using the Bruker Mobile IR equipped with ATR diamond.

Conclusion

ATR-FTIR offered a simple, rapid and non-destructive technique for identification of counterfeit tobacco. Cluster analysis showed to be more accurate than CWS or PCA methods.

Acknowledgments