Authentication and quality testing of distilled spirits using the SPECTROstar® *Nano*

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- **UV-Vis scanning and 'fingerprint' detection enables quality testing and authentication of distilled spirits**
- **SPECTROstar® *Nano* rapidly and efficiently measures multiple samples of distilled spirits**
- **Allows distillers to detect counterfeits and track adulteration**

Introduction

The distilled beverage industry is creating new products at a rapid pace; at the same time it is under constant attack from counterfeiters and those who would adulterate or dilute distilled spirits and liqueurs. Recently, it has been discovered that UV-Visible spectroscopy provides a rapid and powerful tool to test the quality of distilled spirits and to detect adulterated and counterfeit products[1-5].
Distilled spirits are broadly classified as white and aged spirits. As spirits age in the wood they pick up sugars, tannins, other complex biochemical components and color and undergo considerable chemical reactions. This changes the profile of the spirit in complex and still largely unresolved ways. In addition, for some spirit designations coloring, sugar, citric acid and botanicals may be present. Changes in aging and the addition of components may be followed or detected through uv-visible scanning of samples.
The SPECTROstar *Nano* microplate reader can rapidly and precisely measure the spectra of multiple samples at a time. The integrated spectrometer can take spectra over time and the MARS data evaluation software shows overlay plots of all measurements allowing near-real-time evaluation of distilled spirit quality.

Assay Principle

Distilled spirits should be examined undiluted and are tested using small volumes which allow for very short path-lengths; an important criterion when measuring darker colored or more complex spirits and liqueurs.
For purposes of authentication a data library of specific style and brand "fingerprints" is acquired and stored within the MARS software. It is then a simple matter of calling up the appropriate data set to compare with newly acquired sample data and render "go-no go", recall decisions based upon the results obtained.
Typically spectra are recorded from about 250 to 400 nanometers and a notable feature for many spirits is a broad band centered about 280 nanometers, whose amplitude changes according to the type of spirit and brand. Unique fingerprints are defined both from within the same style, and with brand differences depending upon process, blending, additives and aging. Over time a library of product fingerprints can be generated which can help in maintaining product quality, and detecting adulteration of the product.

Materials & Methods

- UV transparent 96-well plates (Costar)
- SPECTROstar *Nano* (BMG LABTECH)

The indicated spirit samples (Figures 2-4) were pipeted into microplates in replicates taking care not to introduce bubbles. Low, 100 µl, volumes were employed and the plates read on a SPECTROstar *Nano*.

Instrument settings	
Measurement mode:	Endpoint
Wavelength Settings:	Spectra
Wavelength Range:	220-1000 nm
Scan Resolution:	2 nm
Path Length Correction:	Off

Results & Discussion

The typical spectral profiles for several types of distilled spirits are presented in Figure 1. The spirits represented a range from white colored silver tequila to aged tequila and through darker colored spirits such as Canadian whiskey, Scotch whisky and three brands of Bourbon whiskey. Thus it is seen that there are broad spirit class distinctions and subtle yet unique distinctions between the same type of spirit.

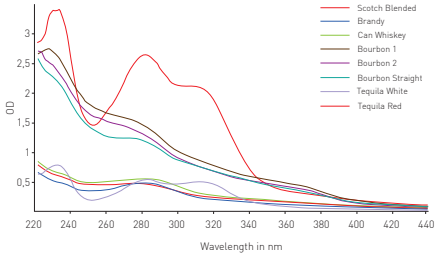

Fig. 1: UV-Visible fingerprint profiles of white and colored classes of distilled spirits.

The distiller is often interested in the desirable aging changes associated with maturation in the wood. While this is a complex topic it is noted again that profile changes can be rapidly monitored by selected timings and spectral analysis (Figure 2). A white whiskey and an un-aged cachaça show a typical low amplitude un-aged profile. The same distillery for the cachaça also produces a classic wood aged product and shows the enhanced amplitude profile typical of such wood aging and is also distinctive for the brand. Furthermore the fingerprint is valid across batches as witnessed by the two aged profiles. The profiles are similar enough to warrant the finding that the uv-visible scanning method is generally valid for detecting and authenticating brands.[3]

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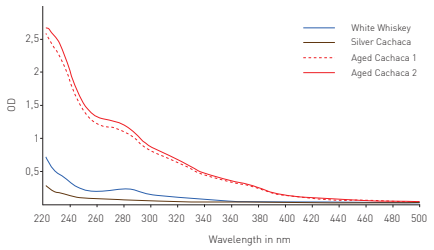

Fig. 2: UV-Visible fingerprint profiles of a white whiskey and un-aged and an aged Cachaça (cane sugar spirit).

Certain spirits are allowed to have a spirit-grade caramel added. The quality of the caramel may be detected in part by spectroscopy (Figure 3). Such information is useful in declared caramel addition or its suspected addition when not expected. Other additives may also be detected in a similar way.

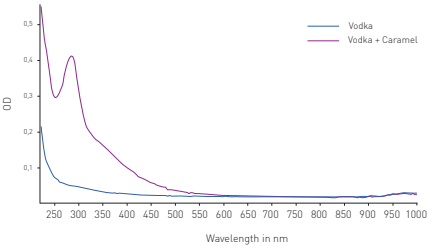

Fig. 3: UV-Visible fingerprint profiles of a white spirit "as is" and after the addition of a spirit grade caramel.

Conclusion

We have shown here the power of UV-visible spectroscopy using the SPECTROstar *Nano* in quality control testing of distilled beverages. It is useful in brand authentication and in counterfeit and adulterant studies. Unlike other instruments on the market the SPECTROstar *Nano* is not dedicated just to this type of work; it can handle multiple samples at a time and can return data on multiple samples in minutes – the same time for one sample by other instruments dedicated to just this application. No sample preparation or dilution is necessary, no blanks are needed and no switching of path-length devices are required making for fast, efficient and precise data collection. Sample size can be as little as 100 microliters and replicate analyses are easy to test in the multi-well, microplate format.

References

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