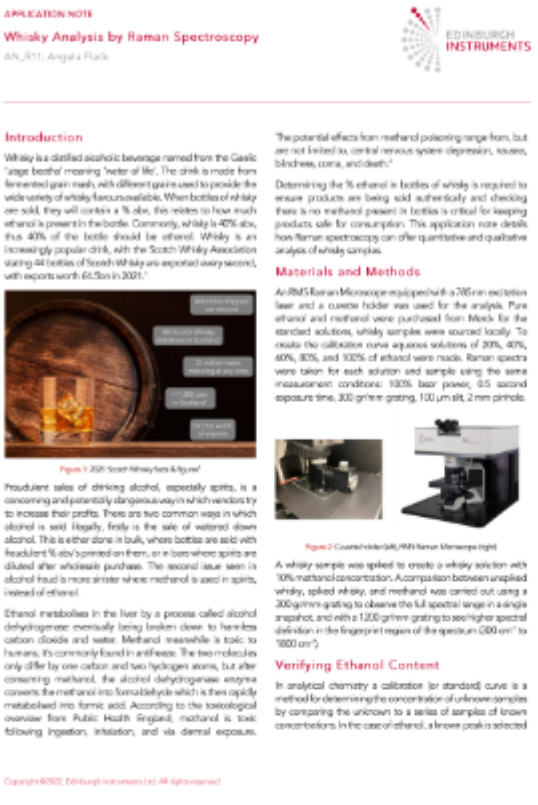
Wednesday, October 5, 2022

PHOTONICS spectra®

WHITE PAPERS & APPLICATION NOTES



APPLICATION NOTE

Whisky Analysis by Raman Spectroscopy

AN_R11; Angela Fluck

EDINBURGH INSTRUMENTS

Introduction

Whisky is a distilled alcoholic beverage named from the Gaelic 'uisge beatha' meaning 'water of life'. The drink is made from fermented grain mash with different grains used to provide the wide variety of whisky flavours available. When bottles of whisky are sold, they will contain a % abv, this relates to how much ethanol is present in the bottle. Commonly, whisky is 40% abv, thus 40% of the bottle should be ethanol. Whisky is an increasingly popular drink, with the Scotch Whisky Association stating 44 bottles of Scotch Whisky are exported every second, with exports worth £6.5bn in 2021.[1]

Figure 1: 2021 Scotch Whisky Facts & Figures[1]

Fraudulent sales of drinking alcohol, especially spirits, is a concerning and potentially dangerous way in which vendors try to increase their profits. There are two common ways in which alcohol is sold illegally, firstly is the sale of watered down alcohol. This is either done in bulk, where bottles are sold with fraudulent % abv's printed on them, or in bars where spirits are diluted after wholesale purchase. The second issue seen is alcohol fraud is more sinister where methanol is used in spirits, instead of ethanol.

Ethanol metabolises in the liver by a process called alcohol dehydrogenase eventually being broken down to harmless carbon dioxide and water. Methanol meanwhile is toxic to humans, it's commonly found in antifreeze. The two molecules only differ by one carbon and two hydrogen atoms, but after consuming methanol, the alcohol dehydrogenase enzyme converts the methanol into formaldehyde which is then rapidly metabolised into formic acid. According to the toxicological overview from Public Health England, methanol is toxic following ingestion, inhalation, and via dermal exposure. The potential effects from methanol poisoning range from, but are not limited to, central nervous system depression, nausea, blindness, coma, and death.[2]

Determining the % ethanol in bottles of whisky is required to ensure products are being sold authentically and checking there is no methanol present in bottles is critical for keeping products safe for consumption. This application note details how Raman spectroscopy can offer quantitative and qualitative analysis of whisky samples.

Materials and Methods

An RM5 Raman Microscope equipped with a 785 nm excitation laser and a cuvette holder was used for the analysis. Pure ethanol and methanol were purchased from Merck for the standard solutions, whisky samples were sourced locally. To create the calibration curve aqueous solutions of 20%, 40%, 60%, 80%, and 100% of ethanol were made. Raman spectra were taken for each solution and sample using the same measurement conditions: 100% laser power, 0.5 second exposure time, 300 gr/mm grating, 100 µm slit, 2 mm pinhole.

Figure 2: Cuvette holder (left), RM5 Raman Microscope (right)

A whisky sample was spiked to create a whisky solution with 10% methanol concentration. A comparison between unspiked whisky, spiked whisky, and methanol was carried out using a 300 gr/mm grating to observe the full spectral range in a single snapshot, and with a 1200 gr/mm grating to see higher spectral definition in the fingerprint region of the spectrum (200 cm^{-1} to 1000 cm^{-1}).

Verifying Ethanol Content

In analytical chemistry a calibration (or standard) curve is a method for determining the concentration of unknown samples by comparing the unknown to a series of samples of known concentrations. In the case of ethanol, a known peak is selected

Whisky Analysis by Raman Spectroscopy

Raman spectroscopy is an analytical technique which can be used both quantitatively and qualitatively. This application note details the quantitative use of Raman spectroscopy to determine ethanol content in samples of whisky. Qualitatively, Raman spectroscopy can also be used for whisky analysis to ensure it does not contain methanol, a toxic alcohol which can be fraudulently used in alcohol sales to boost profits.

DOWNLOAD APPLICATION NOTE

EDINBURGH INSTRUMENTS

More White Papers from This Sponsor

- Measuring Picosecond Fluorescence Lifetimes Using the FLS1000 Equipped with a Hybrid Photodetector
- Fluorescence, Delayed Fluorescence and Phosphorescence Spectra of a TADF Emitter Measured Using the FLS1000 with a VPL Laser and Gated PMT Detector
- Photoluminescence Spectroscopy of Carbon Dots

Visit **Photonics Media** to download other white papers and learn more about the latest developments in lasers, imaging, optics, biophotonics, machine vision, spectroscopy, microscopy, photovoltaics and more.

www.photonics.com/WhitePapers.aspx