N I R L A B

NIRLAB x 8ight Research Labs, A Division of 8ight LLC

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Riccardo Voccio

1. Aim of the work

The aim of this work was to develop an appropriate methodology for the acquisition of samples used at 8ight LLC, including both samples produced by the company and the raw materials employed in the manufacture of the final products.

2. Device description

The portable instrument employed in this study was a NIRLIGHT MicroNIR OnSite-W spectrometer manufactured by Viavi Solutions Inc. (Scottsdale, Arizona, USA) and equipped with Bluetooth connectivity. The device incorporates two vacuum tungsten lamps as the light source and a 128-pixel InGaAs photodiode array detector integrated with a Viavi linear variable filter (LVF). The detector operates over a wavelength range of 950–1650 nm (10,526–6060 cm^{-1}) with a spectral resolution of 6.2 nm across this range. The instrument provides a signal-to-noise ratio of 25,000, an integration time of 10 ms, and acquires 100 scans per measurement. It is powered by a lithium-ion battery with an operating time exceeding 10 h and has a total weight of 250 g.

3. Obtained spectra – Raw materials

Although the kit for liquid analysis was also available, measurements were conducted exclusively on solid materials at this stage. Figure 1 shows a photograph of all the analyzed substances.

Figure 1: Image of all the samples acquired

Given the high homogeneity of these materials, a single spectrum was acquired for each sample by placing the instrument lens directly in contact with the sample surface, following appropriate calibration using a Spectralon reference, which reflects 99% of the incident radiation. The resulting spectra are reported in Figure 2.

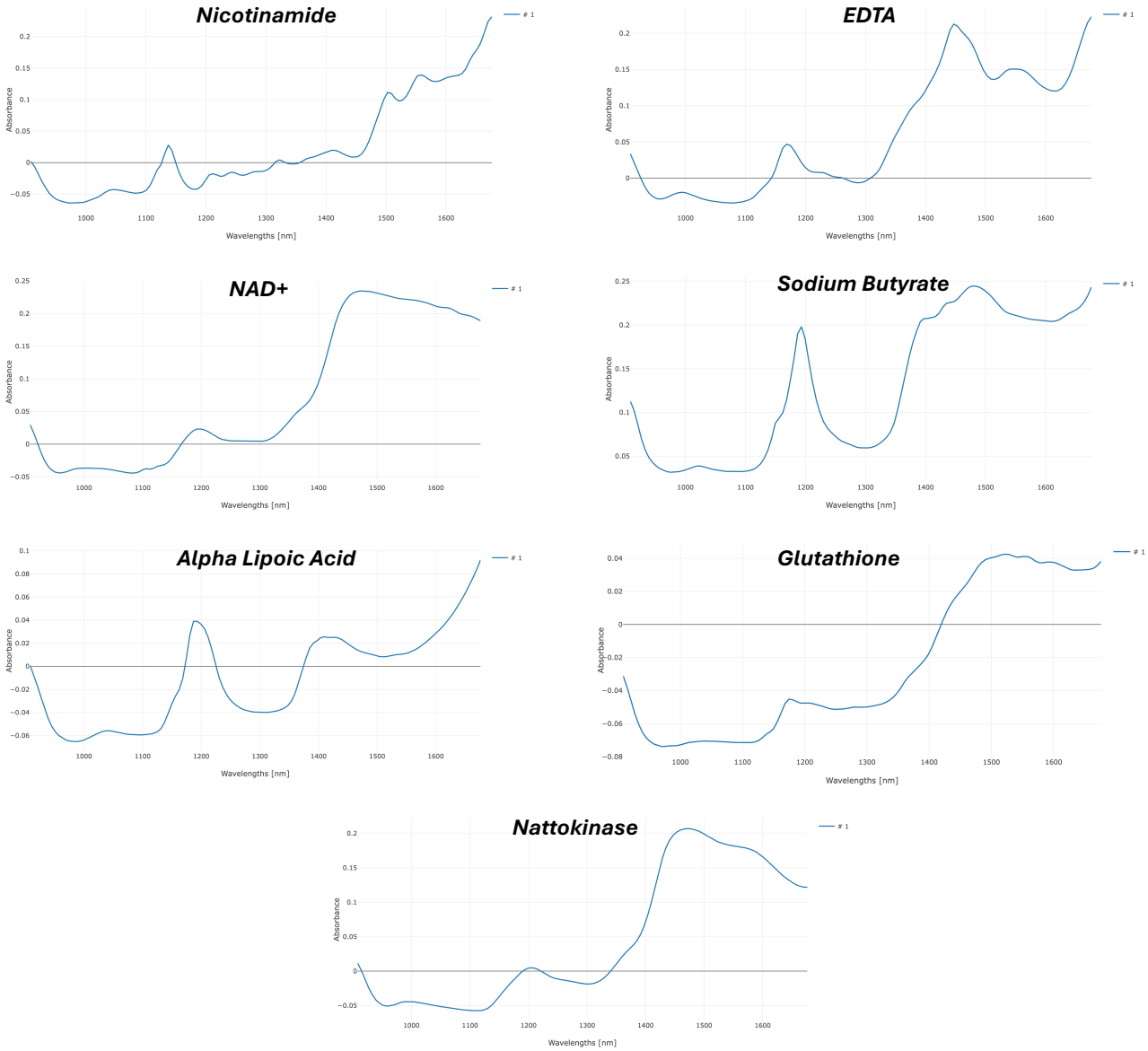

Figure 2: Obtained spectra for all the raw materials

Some raw materials exhibit negative absorbance values, most likely due to their highly reflective nature, as they consist of white powdered substances. Although NIR spectroscopy is not typically employed for detailed functional group characterization because of extensive band overlap, certain characteristic absorptions can still be identified in the spectra shown in Figure 2.

For instance, an absorption band at approximately 1200 nm is observed for alpha-lipoic acid and can be attributed to overtones of C–H stretching vibrations associated

with the aliphatic chain of the molecule. A further absorption around 1400 nm is also present for this compound, likely related to O–H stretching overtones.

A strong absorption near 1200 nm is likewise evident in the spectrum of sodium butyrate, which is consistent with the presence of multiple $–CH_2$ groups and a terminal $–CH_3$ group in its molecular structure.

These results demonstrate that the employed NIR device is suitable for the analysis of a variety of solid raw materials used by 8ight LLC.

4. Obtained spectra – WarrensLove Band Hologram

The device was also employed for the analysis of the WarrensLove Band Hologram. Figure 3 illustrates the acquisition setup used for the material, together with the corresponding spectra obtained from the sample.

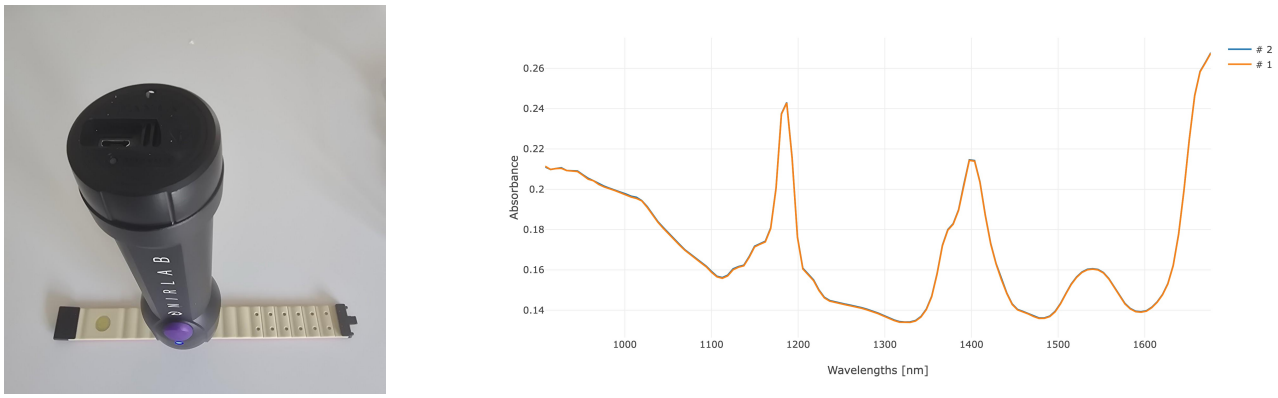

Figure 3: Acquisition modality of wrist band and spectra obtained

Compared to the spectra acquired from raw materials, the wristband spectra are more complex, reflecting the greater chemical complexity of the material, which contains multiple chemical species and exhibits a higher degree of heterogeneity. Nevertheless, since NIR spectroscopy is capable of detecting even subtle variations in chemical composition, the application of this tool to the analysis of such materials is of considerable interest and holds promise for future applications.

5. Obtained spectra – WarrensLove Band Hologram and pure substance: comparison

A WarrensLove Band Hologram was acquired together with the pure nicotinamide in the same analytical session. The spectra obtained are shown in Figure 4.

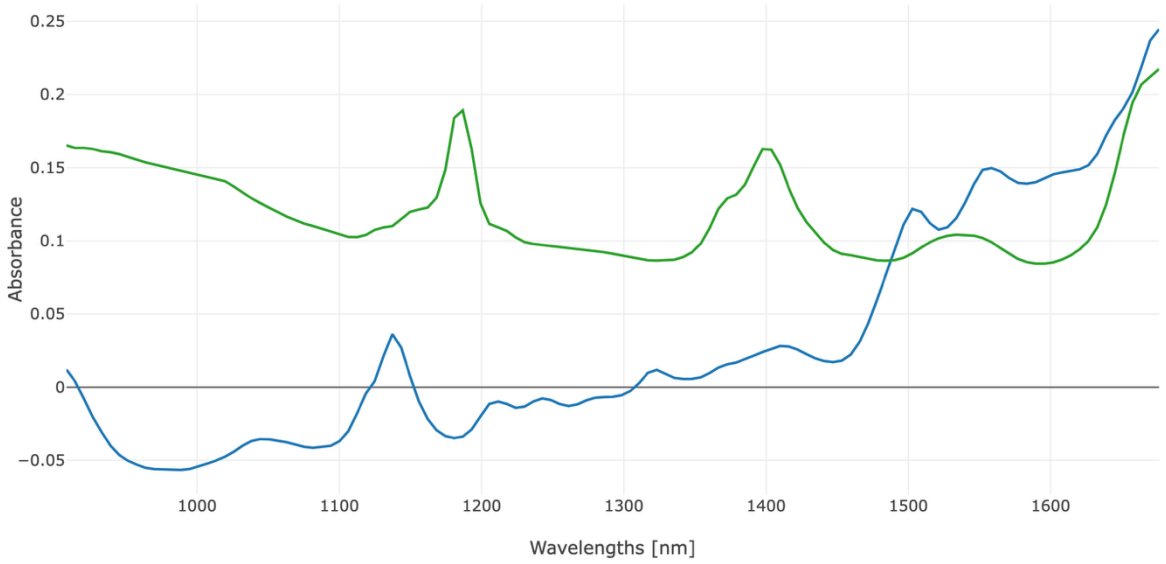

Figure 4: NIR Spectra of pure nicotinamide (blue) and WarrensLove Band Hologram (green)

As observed from the raw spectra acquired for nicotinamide and the wristband, both similarities and differences are evident. In particular, an absorption band in the 1100–1200 nm range is present in both materials. However, as previously noted, the wristband spectrum is more complex due to the presence of a larger number of constituent materials. Acquiring additional spectra from wristbands containing nicotinamide could support the development of a model for detecting the presence of nicotinamide within the sample.