Supelco®
Analytical Products

Application Note

Enhancing Analytical Workflow: ChemisTwin™ Portal for Automated Structure Identification and Quality Control

Using NMR Spectroscopy

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Introduction

In the last decades, highly pure physical reference materials have played a crucial role in analytical and pharmaceutical chemistry which have been used for the structure verification and quantification of main compounds and excipients. We want to keep shaping the future of analytical testing by building an online platform that provides analytical solutions englobing different techniques. The ChemisTwin™ portal contains an extensive database of digital reference materials (dRM), serving as digital twins of the physical reference materials. ChemisTwin™ leverages NMR Workbook Suite automation and spectral comparison technology to automatically compare the sample with the dRM, providing our customers with a detailed report. This offers a readily available, more sustainable, significantly less involved, and more error-proof solution. In this application note, we will discuss the benefits of using ChemisTwin™ and compare it with the manual classical method for identity verification of a target compound versus its closely related compounds using NMR spectroscopy.

Results and Discussion

For this study, ibuprofen was chosen as the molecule to be automatically verified using the portal and was compared with the closely related compounds considered as impurities according to Pharmacopeia[2] (**Figure 1**). Ibuprofen was dissolved in Chloroform-d, and its spectrum was recorded using a 500 MHz spectrometer. The spectrum was then converted into a .jdx file and uploaded into ChemisTwin™. The qualitative verification analysis workflow was selected, followed by the selection of the 9 dRMs (**Figure 1**) to be compared against the sample spectrum. ChemisTwin™ provided a table on the result page containing proton assignments, along with the sample and the dRM predicted spectra, considering the sample's experimental conditions (solvent and instrument frequency), and the match factor score between the sample and the corresponding dRM.

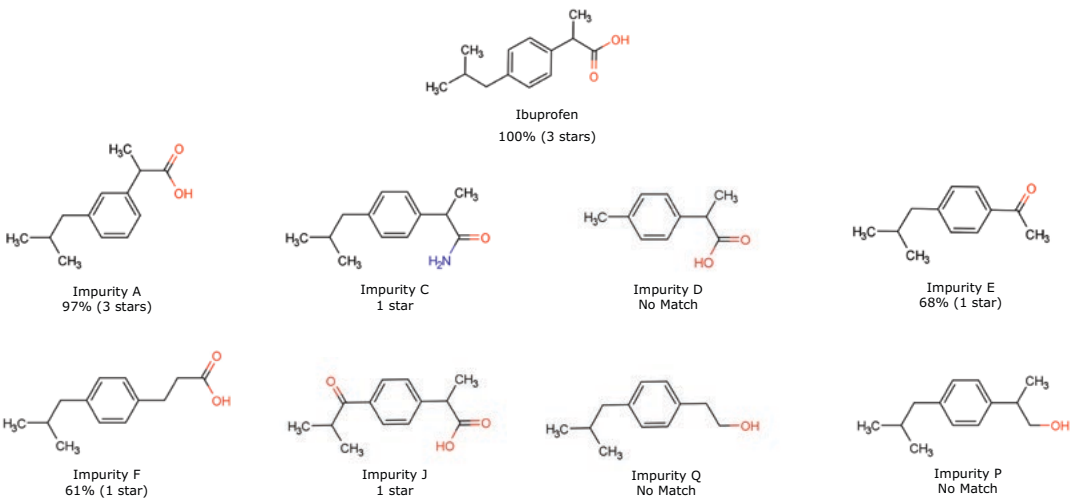

Figure 1. Structure of Ibuprofen and related compounds along with the corresponding match factor from ChemisTwin™.

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ChemisTwin™ was able to find a satisfactory result (100%, 3 stars) with Ibuprofen suggesting that it's the correct molecule. Ibuprofen Impurity A was listed with a high match factor (97%) due to highly similarity of the spectra (0.1 ppm difference in few peaks). Visual comparison of the spectra allows the customer to discriminate this candidate. The related compounds C, E, F, and J fall into the unsatisfactory range (match factor lower than 75%, displayed as 1 star) suggesting that those compounds are not the samples' identity. This can be also in intuited by the spectra difference and the table of assignment report. Impurity D, Q and P found no match (match factor <50%) with the sample spectrum.

To understand the difference between the manual classical quality control method and the digitalized automated process in ChemisTwin™, the same experiment was conducted by three members of the quality control team. The classical procedure involved verifying Ibuprofen as the main component of the spectra and discriminating ibuprofen impurities. This entailed manual post-processing and interpretation of the spectra, followed by comparison with literature data of different compounds to identify the structure's compound. The automatic verification performed by ChemisTwin™ followed a similar approach described at the previous section. Both methods were time-monitored, revealing that the conventional QC approach took 2 to 3 times longer than using ChemisTwin™ (**Table 1**).

Table 1. Results of the manual conventional quality control method versus ChemisTwin™ for identity verification of a target compound versus its closely related compounds using NMR spectroscopy

QC Member	Manual QC (min)	ChemisTwin™ (min)
1	10.6	5.2
2	32.3	9.4
3	20.8	13.1

Conclusion

The comparison between the manual classical method and the automated process in ChemisTwin™ highlights the significant advantages of the latter. ChemisTwin™ streamlines the verification process, providing accurate results in a fraction of the time required by traditional methods. Furthermore, its digital nature eliminates the need for extensive manual interpretation and literature comparison, enhancing efficiency and reducing the potential for errors. Overall, ChemisTwin™ represents a valuable tool for quality control in compound identification via NMR spectroscopy, offering improved speed, accuracy, and reliability.

References

1. https://chemistwin.com
2. European Pharmacopoeia 11.0

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