

Supporting Information (S-6)

A Complete Structure Investigation of an Organic Molecule for Chemistry Students; An Analysis of Aspartame

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Teacher's Notes

Overall, the laboratory project was an enjoyable experience, and the students had a steep learning curve during the project period. The students' motivation increased throughout the project.

The students were relatively self-driven in the laboratory when performing the UV and IR analyses, as they had prior experience with these instruments from an earlier course. This part could easily be scaled up to include additional groups working in parallel, given the availability of UV instruments in the laboratory, and the relatively short time required for IR analyses.

Preparation of the NMR and MS samples was also carried out by the students. However, there was not enough time for them to become familiar with the processing of MS and NMR spectral data. For these instruments, the students were guided through the instrument protocol to obtain the ^1H -NMR spectra and were provided with the spectra that were the most time-consuming to produce (^{13}C - and DEPT NMR). Each group received individual instructions, and the students actively asked questions. This part could have been partially scaled up to include additional groups if the theoretical content had been explained in a joint session; however, the limited availability of instruments restricted the expansion of the practical component.

The total time required for the students to analyze and process the spectra of the five compounds, including aspartame, is shown in Table S9.

Table S9. Time required for the entire project and specifically for aspartame

	Time required for the experimental work of the project per group	Time spent on the aspartame analysis per group
UV- analysis	1.5 h	30 min
IR - analysis	1 h	30 min
NMR- analysis	2 h	30 min
MS- analysis	2 h	30 min

Aspartame was the most complex molecule in the project, while the other molecules (salicylic acid, acetylsalicylic acid, ibuprofen, and an unidentified paraben) helped the students interpret the structure by comparing the spectral results with those of the other molecular structures. In the project, the MS technique was the most challenging method to achieve student involvement, as they were quite passive during the processing part, while the sample preparation was very easy.

On average, over three following courses, the instructor used 12 hours guiding four groups in the laboratory. In addition, four hours were spent reviewing written reports, and three hours were spent on oral presentations.