

Raman spectroscopy & RAMANMETRIX™ as a Versatile Process Analytic Tool

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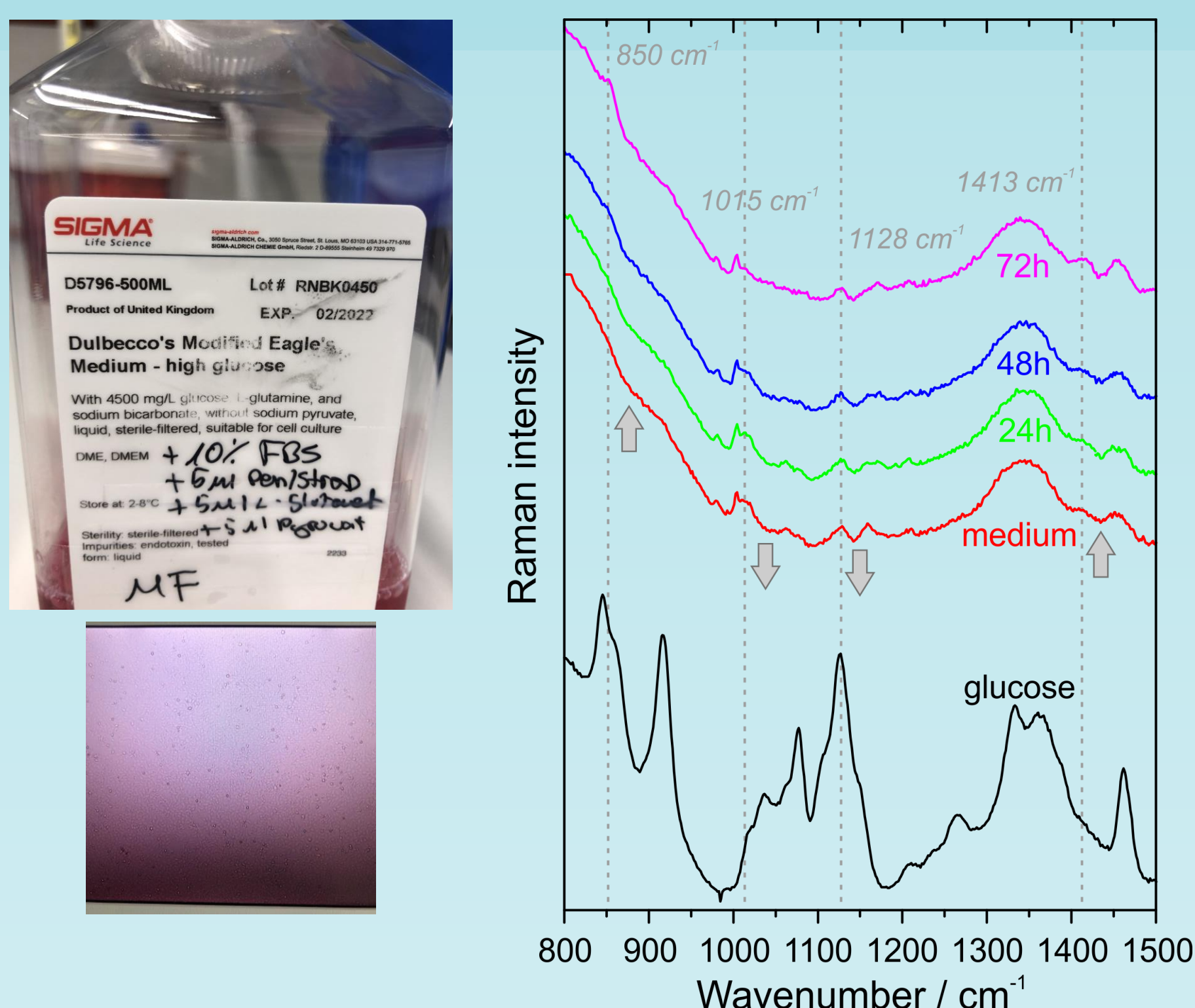
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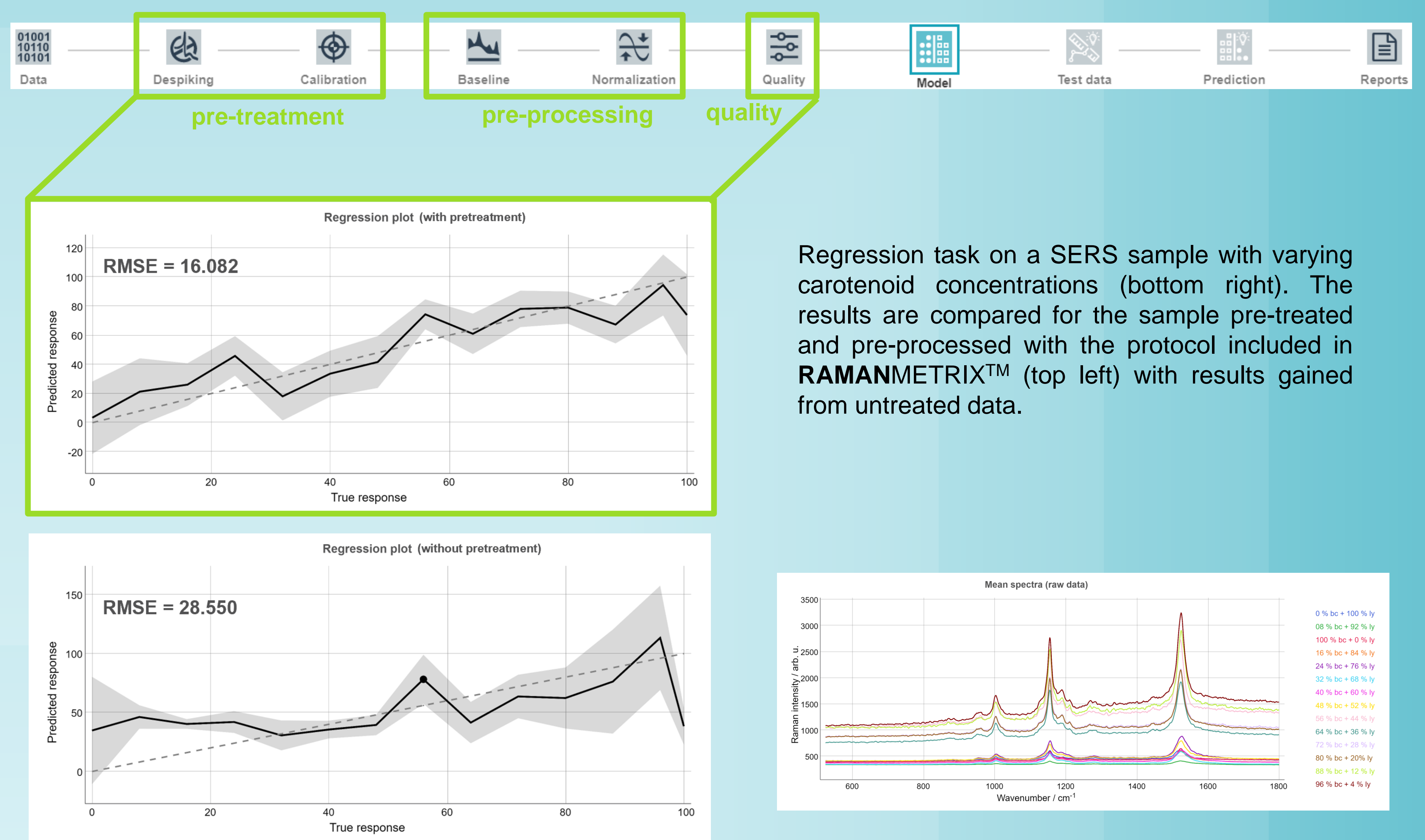
Introduction: Bioreactor synthesis has become one of the most important techniques for efficient production of essential pharmaceuticals in high yield and it also plays an important role in the food production. However, due to the dependency of these processes on living organisms they represent complex and demanding systems which require fast and high-performing process analytic instruments allowing a defined control of the process as well as a prompt intervention in the case of perturbations. In our work, we discuss two instruments, namely Raman spectroscopy and our AI-based software tool **RAMANMETRIX™**, which combination is highly potential to fulfill these requirements. For this we present a qualification task carried out by Raman spectroscopy and a quantitative analysis within **RAMANMETRIX™**.

Glucose tracking by Raman spectroscopy



Qualitative study on the glucose development in a cell culture medium with a complex matrix under bacterial growth. **Left:** Cell culture medium (top) and microscopic image of the cell culture (below). **Right:** Development of glucose-specific Raman features (marked by arrows down) and metabolites (marked by arrows up) in the cell-culture medium recorded at different times from a cuvette with 785 nm excitation. The glucose reference spectrum is depicted for comparison.

Enhancing the model quality by preprocessing Raman data within RAMANMETRIX™



Regression task on a SERS sample with varying carotenoid concentrations (bottom right). The results are compared for the sample pre-treated and pre-processed with the protocol included in **RAMANMETRIX™** (top left) with results gained from untreated data.

RAMANMETRIX™ Pre-Treatment and Pre-Processing Datapipeline & Model Building

Conclusions: Considering the results from both presented topics, a combination of the glucose response gained by Raman spectroscopy and the pretreatment and analysis protocol from our **RAMANMETRIX™** could provide a novel and highly advantageous PAT tool to monitor and adjust the bioreactor-based synthesis.

Literature: A. I. Radu, O. Ryabchykov, T. W. Bocklitz, U. Huebner, K. Weber, D. Cialla-May, J. Popp, *Analyst*, **2016**, *141*, 4447–4455.