Industry is focusing increasingly on the development of more efficient and less time-consuming methods to monitor and control their fermentation processes at optimal conditions. Note that, fermentation processes are often the most complex step within biomanufacturing. Nevertheless, the detailed understanding of the process is often lacking and control decisions are frequently introduced manually based on experience instead of process data. We want to assess industrially relevant fermentation processes with advanced but still rather uncommonly used cutting-edge technologies thus developing new monitoring methods while improving the integral understanding and success of the process. Aiming at robust and generic on-line monitoring techniques the focus of our research lies on a state of the art insulin production process by yeast. Our research comprises spectroscopy and image analysis combined with chemometric modelling as a promising approach supplementing the future online sensor toolbox.