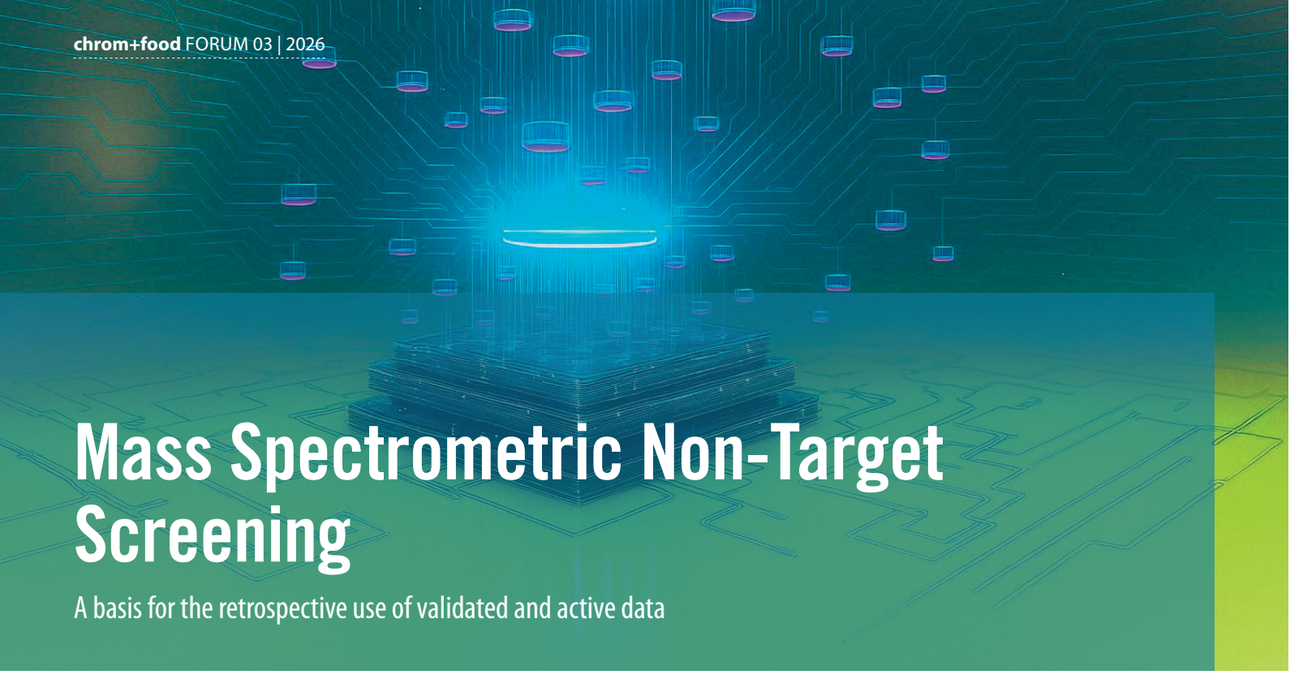

Mass Spectrometric Non-Target Screening

A basis for the retrospective use of validated and active data

Dr. Stefan Bieber | PD Dr. Thomas Letzel

With the increasing establishment of machine learning and artificial intelligence there is now an opportunity to provide direct points of contact between NTS data and in-depth data analysis.

Thirty years ago, the term (mass spectrometric) non-target screening (NTS) was initially mentioned in a scientific publication by K. Bester et al. for water analyses with GC-MS [1]. Ten years later, the term 'NTS' was taken up again and used by A.R. Fernández-Alba's group for LC-MS studies in food [2] and by F. Hernandez's group for LC-MS studies in water [3]. Another almost five years later, we discussed NTS, Suspects Screening and Target Screening and "Known Unknowns" and "Unknown Unknowns" in more depth [4]. In the following year, Schymanksi et al. defined a first scheme for identification classes of compounds in the NTS [5]. In 2019, a first comprehensive and practical NTS guide was presented (including extensively discussed classification for identification [6]) and was made available free of charge to the international NTS community [7]. In 2025, the most up-to-date version of a practical NTS guide was published [8]. This includes (as an updated version of [7]) for the first time the proposal for a sector-relevant NTS reference mix, chapters on validation and quality assurance as well as a significantly expanded chapter on statistical evaluation.

In the past thirty years, the practical application of sampling, sample preparation and instrumental analysis (in chromatography and mass spectrometry) has been consistently further developed and optimized to this day for the 'mass spectrometric scanning' of 'ions'. From the former analytical type of exclusively 'searching and identifying unknowns', one has now progressed to a universal well-established, documented and routine analysis strategy.

Figure 1 schematically reflects the level and workflow of digital information collection and use. On this basis, it is now possible to process data from the NTS together with those from (classical) quantitative analysis and to transfer it into a general (but also interactive) reporting of the data (see Fig. 1, top right).

However, the practical analysis steps and processes also ultimately lead to numerous data sets, both in instrumental analytics itself and in data acquisition, data processing, data utilization and data evaluation. The handling, storage and availability of these different data (levels) is currently the biggest challenge in NTS, but at the same time it also holds a great opportunity.

The data storage concepts already established in many laboratories (e.g. in archiving laboratory information management systems (LIMS) or electronic lab notebooks (ELN)) and other digital approaches can be combined via interfaces in new, future-proof data usage concepts (see also Fig. 3 in [9]). In addition, data can also be machine-readable and actively stored via interfaces in so-called 'holistic NTS data management platforms' – such as the 'NTS-Hive' (Fig. 1 bottom) - and FAIR [10] can be applied in a smart way (not least in combination with the 'LIMS archives').

NTS-Hive is based on Open Semantic Lab [11], extended by structured metadata [12] and allows NTS data and all (sample) relevant data to be kept permanently available. At this level, it is then possible to evaluate NTS data across data sets using various other evaluation programs and tools. This allows prioritization, annotations, and identifications of NTS data to be carried out more reliably and on a broader basis. This also opens up the possibility of retrospective data viewing and evaluation, which was previously only possible with great effort. With the increasing establishment of "machine learning" and neural networks (often used as artificial intelligence, AI), there is now an opportunity to provide direct points of contact between NTS data and in-depth data analysis. Machine learning tools and artificial intelligence can come, the instrumental (NTS) analytics and their retrospective use of data is ready.

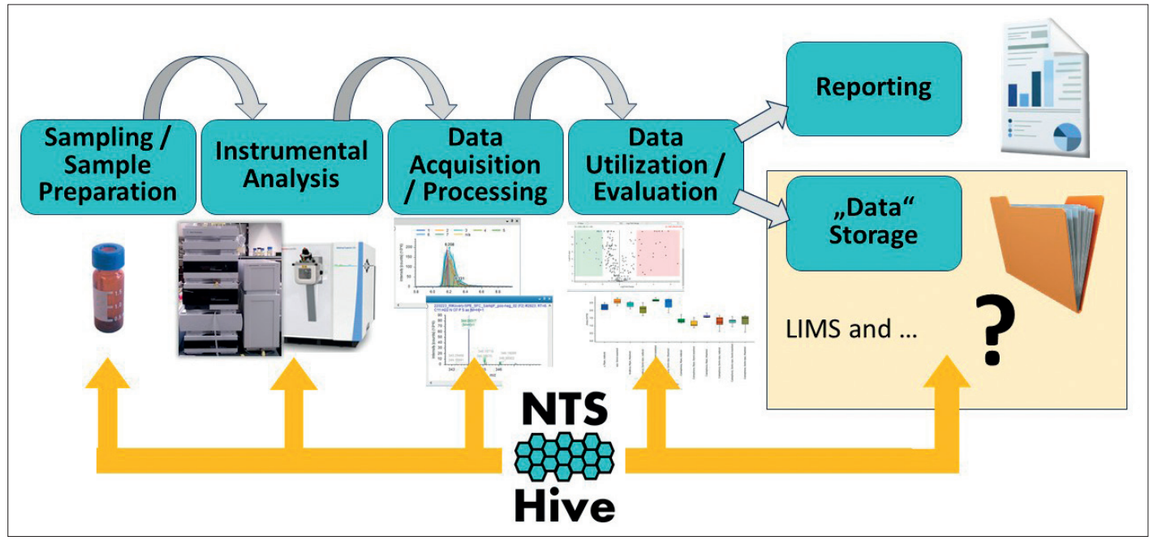

Fig.1: Schematic representation of a retrospectively usable workflow concept based on the (open semantic lab) NTS-HIVE platform as a holistic core of data storage, handling and interpretation as well as a starting point for application in systems for intelligent data use.

You will find us during the analytica 2026 in Munich from March 24–27, 2026 in Hall A3 at the Bayern Innovativ joint booth 311.

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