proceedings

MDPI

Proceedings

Quality and Reliability in Analytical Chemistry †

Raluca-Ioana Stefan-van Staden

Laboratory of Electrochemistry and PATLAB, National Institute of Research for Electrochemistry and Condensed Matter, 060021 Bucharest, Romania; ralucavanstaden@gmail.com; Tel.: +40-751-507-779

† Presented at the Virtual Eurachem Workshop 2020—"Quality Assurance for Analytical Laboratories in the University Curriculum", 14–15 July 2020; Available online: https://eurachem2020.ro/.

Published: 21 September 2020

Abstract: Quality and reliability are essential terms in analytical chemistry. Reliable analytical information implies quality. Maintaining the quality in time shows reliability. Evaluation of quality and reliability is essential for the validation of a new method of analysis. Learning good practice in analytical chemistry during undergraduate studies will improve the quality of the laboratories of analysis, by implementing highly reliable analytical methods.

Keywords: quality; reliability; analytical chemistry

1. Introduction

Developing new methods or applying an old method to the determination of analytes from new matrices are essential activities in the laboratories of analytical chemistry. Accuracy and reliability of the measurements always has to be demonstrated. Accuracy is defined as the quality of the analytical method developed to determine certain analyte(s) from different matrices. Both quality and reliability are related to the main steps of the analytical process: input (given by the sampling process), black box (the actual measurement), and output (all chemometric processes able to transform the analytical signal in concentration of the analyte(s)) [1,2]. Teaching undergraduate students about quality and reliability in analytical chemistry is essential, not only for a career in research and industry or accredited analysis laboratories, but also for a career in the teaching of chemistry.

2. Correlation of Quality and Reliability with the Steps of the Analytical Process

Quality is the first parameter to be determined for the analytical process. When one is assessing the quality, they should look to the sampling process, to the analytical method itself, and also to the output (data that should be fast and easily processed). While one can have an excellent method of analysis with high sensitivity and selectivity for determination of the analyte(s) from their standard solutions, one should look to the quality of the sampling, because complex matrices often cause uncertainties. Therefore, sampling is one of the most important steps in the analytical process, because it can influence the quality and reliability of the analysis.

Sampling comprises the following steps: picking up the sample, physical (e.g., separation of serum from whole blood, dissolution of solid samples in water or organic solvents) or/and chemical (extraction of the main analyte(s), transformation of the analyte(s) in compound(s), which can be easily measured, elimination of interfering compound(s), etc.) processes. The history of the sample is essential to know before starting the sampling and selecting the method to be used in the black box of the analytical process. The history of the sample may give the analytical chemist an idea about the composition of the matrix, complexity of the matrix, stability of the sample and also of the analyte(s) to be determined.

Sampling must be correlated with the method and instrument being used in the black box of the analytical process in terms of selectivity and sensitivity. One can increase the selectivity, and accuracy

of determination by masking the interferences, or by extraction using organic solvents or the spinning of the samples. Chromatographic methods are also used in the sampling process, separation with pre or postcolumn derivatization is involved in sampling processes in order to send to the detector the analyte in a measurable form, and free of interferences. Improvement of the separation columns in terms of length, diameter, coating, is done to obtain high quality and reliability for the sampling process. Derivatization processes can also improve the quality of the sampling, and also may influence the quality and reliability of the results of the analysis.

The black box comprises the analysis itself. Quality and reliability of the method selected for the determination of the analytes must be correlated to the sensitivity of the instrument and to the samples processed during the sampling/inbox process. Only a good correlation will produce high quality data. Reproducibility of the analytical information obtained in the black box will influence the reliability of the analytical information.

In the last part of the analytical process (output), the analytical information obtained from the black box will be transformed in concentration. Data processing and statistics will have a very important role in establishing the accuracy and reliability of the final results.

3. Quality, Reliability and Validation of the Analytical Process

Only high quality and reliable analytical processes in terms of sensitivity, selectivity, accuracy can be considered for validation. A very important step in validation is the recovery test, performed using the addition of known amounts of analyte(s) in real samples. Recoveries higher than 90.00% will allow us to begin the analysis of real samples using the proposed sampling/analytical method/data processing and chemometrics. The data obtained after the analysis using the proposed analytical process must be compared with data obtained using a well-established method or/and a standard method. Student *t*-test is the most used method for assessment of the accuracy of the method. When the quality of the analytical process can be retained in time, the analytical process is declared reliable.

Good laboratory practice is a requirement for the assessment of quality and reliability of an analytical process and also for its validation using real samples.

4. Conclusions

Correlation of the complexity of the matrix, of the history of the sample, of the sampling process with the method of analysis and data processing using statistics is essential for obtaining the quality and reliability parameters for analytical process. Validation is essential for all reliable analytical processes using real samples. For the best results, one needs to have knowledge about good laboratory practice. The teaching of analytical chemistry by professors specialized in analytical chemistry with knowledge from this discipline is essential in order to produce trained students for research, standardized/accredited laboratories, and industry. Quality of life is highly related to the quality and reliability of the analytical process because nothing can be commercialized or used (in the case of a method) without having a document certifying the quality and reliability.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Aboul-Enein, H.Y.; Stefan, R.I.; Baiulescu, G.E. *Quality and Reliability in Analytical Chemistry*; CRC Press: Bocca Raton, FL, USA, 2000.
2. Springer, D.C.; Stefan, R.I.; van Staden, J.F. *Laboratory Auditing for Quality and Regulatory Compliance*; Taylor and Francis: New York, NY, USA, 2005.