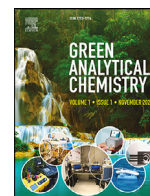




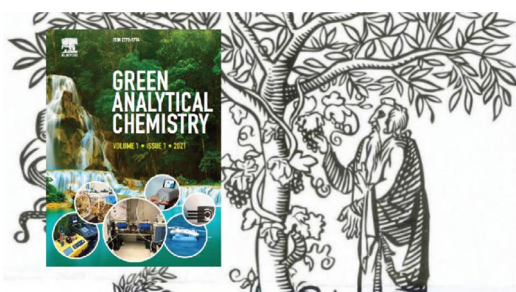
Contents lists available at ScienceDirect

Green Analytical Chemistry

journal homepage: www.elsevier.com/locate/greeac

Editorial

Green analytical chemistry-a new Elsevier's journal facing the realities of modern analytical chemistry and more sustainable future



The mission of GREE(N)AC

Nowadays, all sciences, including chemistry and chemical engineering, are developing very dynamically. This can be seen in the rapidly growing number of scientific publications and citations in almost every field. Analytical chemistry is no exception and the possibilities of modern analytical methods have never been so great. The developed technological and methodological solutions allow for the determination of analytes at lower and lower concentration levels, separation of more and more complex mixtures, achieving precision and accuracy previously unreachable, while requiring even smaller amounts of material, ensuring even better speed of analysis and simplicity of use. Regardless of the development of analytical and practical possibilities, an important trend currently observed in analytical chemistry is the desire to reduce the negative impact of newly developed methods on the environment and to increase their safety. This idea, known as "green analytical chemistry" [1–3], is vividly expressed as "greening" of the applied procedures, which, however, does not always go hand-in-hand with the pursuit of maximum in analytical and practical/economic effectiveness. Therefore, it is essential to find an appropriate balance that would be consistent with the idea of sustainable development. For that reason, to meet these expectations, Elsevier has launched a new journal-*Green Analytical Chemistry (GREE(N)AC)*. Its main mission is to offer developers and users of new analytical methods an original platform for publishing analytical solutions and exchanging ideas, facing the realities of modern analytical chemistry and creating a more sustainable future.

A natural objective of *GREE(N)AC* is to promote functional (fit-for-purpose) methods that minimize or eliminate the use of toxic substances or generation of waste, employ screening methods for simple qualitative (yes/no) measurement, avoid processing of large numbers of samples, and implement analysis with on-site and *in-vivo* technologies. This jour-

nal will emphasize developments of on-site instrumentation (with both engineering and chemistry aspects), on-site sampling (both statistics and instrumentation), novel approaches to eliminate or reduce substantially the use of organic solvents and toxic reagents (both in high throughput laboratory determinations as well as on-site screening). Both novel green analytical chemistry approaches and modified traditional schemes, will be suitable for publication in the journal. Articles published will also support the development of green analytical regulatory methods, which will contribute to a reduced ecological footprint of humans on the Earth. The published material will assist educators at universities to have literature references to promote green approaches in their courses.

In summary, the Scope for *GREE(N)AC* will include:

- Fundamental developments facilitating green analytical chemistry technologies/methods
- Development of ecodesigned sensors and biosensors
- Reuse of the devices to reduce waste
- Alternative solvents, replacing hazardous compounds, solventless extraction techniques
- Miniaturization, making it possible to reduce dramatically the amounts of reagents consumed and wastes generated
- Reducing or avoiding side effects of analytical methods
- Reducing time and energy
- Environmentally friendly sample preparation techniques
- On-site analytical instrument development and sampling protocols
- Fully or partially automated techniques to perform the analysis of environmental and biological samples parameters, in an accurate, safe, fast, and efficient way
- Flow cells
- Green physicochemical and structural analysis,
- Green Chemistry Education
- New strategies of assuring quality in analytical chemistry by following the goals of sustainable development, developing assessment methods and validation standards

GREE(N)AC will accept the following types of papers: *Original Research Papers, Short Communications, Technical Notes, Critical Reviews, Perspectives and Protocols*. The format and length of submitted manuscripts should be adjusted to the guideline for authors concerning the individual types of articles, published on the journal's website. Otherwise, the authors will be asked to resubmit the manuscripts or adapt them to the guideline at the review stage, depending on the extent of required modifications. Researchers interested in publishing articles in the

<https://doi.org/10.1016/j.greeac.2022.100001>

Critical Review, Perspective or Protocol formats are encouraged to contact the Editors in advance and consult the idea.

A new article type-protocol

GREE(N)AC is the first research journal in the field of analytical chemistry which will publish *Protocols*. These articles are detailed descriptions of previously developed analytical methods in the form of a ready-to-use recipe, along with key information facilitating its implementation and comparison against other competing methods.

The main objective of *Protocols* is to describe the procedures already developed by analytical chemists, which are generally appreciated and applied in the analytical community. The authors should have sufficiently extensive and documented experience in using the described method. It is not necessary that the authors of the *Protocol* were also the authors of the original method. In addition to analysts working in academia, *Protocols* can be written by researchers using the method of interest as a routine procedure in their daily laboratory work in the commercial and industrial sectors. Presented methods can incorporate minor modifications and improvements over the primary methods, for example highlighting the green aspects of the method, however without affecting the physicochemical fundamentals. Every method described as a *Protocol* should be appropriately validated, even after minor modifications.

Publication in the format of a *Protocol* is especially recommended to authors/users of high-quality analytical methods consistent with the concept of sustainable development and interested in its popularization and promotion of methodological/instrumental innovations used. The described methods can be used in laboratories with different specificity, not necessarily analytical, e.g. for the analysis of the composition of chemical synthesis products. Proposals from different geographical regions, e.g. from economically less developed countries, showing standard methods that are in use in the reality of the limited availability of laboratory infrastructure, will also be very welcome. This new format of articles published in the *GREE(N)AC* journal will be especially useful for researchers interested in quick and smooth implementation of well verified methods addressing specific analytical problems, and their factual comparisons to other alternative methods.

All formal requirements and detailed guidelines for *Protocols* are available to readers on the journal's website.

Method evaluation

The ability to reliably evaluate an analytical method is critical, as it allows researchers to assess how its features and performance compare to alternative methods, thus enabling them to select the best method for a given application. To this end, the method's analytical capabilities, including accuracy, precision, limits of detection and quantification, and linearity range, are assessed using a validation process that is defined by detailed guidelines. The comparison and evaluation of these parameters is relatively simple, as data related to these parameters is typically provided in descriptions of new methods published in recognized scientific journals. Validation based on current standards is useful in selecting the best method with respect to analytical performance, but it is less useful in a holistic evaluation. Firstly, the actual functionality of a method is largely determined by practical and economic aspects such as the speed and cost of analysis, the method's simplicity, and requirements relating to sample quantity, portability, infrastructure, and personnel. Secondly, given the immediate need to halt climate change and minimize environmental degradation, it is crucial to determine the extent to which the assessed method meets the requirements of green analytical chemistry [1–3].

It is necessary to consider all these criteria to ensure the comprehensiveness of the assessment, and it is crucial to evaluate them in a

reasonable, fair, and maximally simple way. The rigorosity of the assessment of functional parameters should reflect the circumstances and specifics of the method's planned use (fit-for-purpose); while the assessment of greenness should be balanced to avoid under- or overestimating this factor. It is also worth noting that the idea of sustainable development goes actually beyond environmental aspects, and considers how to develop and utilize new advanced technology in a reasonable manner that is responsible with respect to its impact on nature and future generations.

A concept that combines all these aspects is the recently proposed "White Analytical Chemistry" (WAC) [4]. According to WAC, the complete method, fully tuned to the expected application, is classified as white, i.e. it combines the three primary light colors: red, green, and blue, which coexist with each other giving the color white as a final effect. Red indicates that the method is analytically effective; green – environmentally friendly and safe; and blue – practical and economical. A tool created to facilitate the assessment of analytical methods in terms of WAC concept is the RGB 12 algorithm, referring to the 12 principles of WAC. Apart from RGB 12, the holistic method evaluation is possible via HEXAGON and multi-criteria decision analysis methods [5].

An alternative approach to method assessment and selection is to focus primarily on their green aspects. Several tools for assessing the greenness of a method have been proposed in recent years, including (i) the National Environmental Methods Index (NEMI) [6], (ii) the Green Analytical Procedure Index (GAPI) [7], (iii) the Eco-Scale [8], and (iv) the Analytical Greenness Calculator (AGREE) [9]. These tools allow a method's greenness to be expressed graphically using specially designed and easy-to-interpret pictograms (NEMI, GAPI, AGREE) and/or using quantitative indicators (Eco-Scale, AGREE). These metrics are straightforward in use, and they are often applied to supplement method validation. It should be emphasized that because of their primary purpose they do not give a full picture of the method's possibilities and its sustainability. Nevertheless, they offer a simple choice of a more eco-friendly method, which may be useful in the case of narrowing down the set of considered methods to those meeting the requirements in terms of other criteria.

Regardless of the choice of the assessment tool, all methods published in *GREE(N)AC* should be properly validated and discussed in both functional and ecological terms, as indicated by the adopted name of the journal.

Perspective

We strongly believe that *GREE(N)AC* will appeal to everyone who has so far appreciated the quality offered by the other Elsevier's journals known for their impact and reputation in the analytical community, and will soon become a recognized forum for promoting high-quality sustainable analytical methods. As editors, we will pay attention to the quality of the published articles, while ensuring a fast and fair peer-review process. We encourage everyone to publish new scientific material in our journal, and thus to be its Creator with us from the very beginning.

May our joint efforts and aspirations bring us closer to a better and more sustainable tomorrow...

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