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Brief Notes on Analytical Chemistry with Bio Solvents

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Abstract

The use of green solvents, some of which are biobased, is one of the current developments in green analytical chemistry. The growth of the biorefinery idea has also made it possible to produce more biochemicals more effectively from a larger variety of feedstocks. Terpene, alcohol, and ester extractions were some of the early applications of biosolvents in analytical processes. However, numerous additional reports of the use of biosolvents in the extraction of bioactive chemicals from other plant materials have also been made, suggesting that there may be more analytical uses for them in the future. Additionally, it should be emphasised that not all biobased solvents used in analytical chemistry are environmentally friendly because some of them might be harmful to aquatic life.

Keywords: Biobased economy; Biobased solvents using green analytical chemistry; Biorefineries, Renewable resources, Extraction

Case Presentation

The 12 principles of green chemistry are introduced into analytical laboratories as part of the idea of "green analytical chemistry" (GAC) [1]. The major objectives of this movement toward greener chemistry include the application of less hazardous reagents, derivatization agents, and solvents [2, 3], as well as the miniaturisation of analytical techniques, particularly extraction techniques. Using solventless extraction methods is the best approach to put the GAC's ideals into practise. The idea of cleaner analytical chemistry was intuitively introduced into the field of analytical chemistry long before the term "GAC" was first used, it should be highlighted. The use of green solvents is one of the trends in current analytical chemistry. These can be ionic liquids, supercritical fluids, deep eutectic solvents (DESs), or less toxic chemical [3-10] solvents. The latter three examples, however, call for the use of complicated tools or modified machinery, or their environmental friendliness has been questioned, as in the case of ionic liquids, given that they frequently exhibit high toxicity toward aqueous organisms. Ionic liquids' insignificant vapour pressures are advantageous because there is little risk of inhalation exposure, but they are not compatible with gas chromatography due to this attribute. DESs are a class of ILs that are often affordable, simple to make, and biodegradable. The ability to get DESs from biosources is another benefit; this is especially true with choline derivatives, organic acids, and aminoacids. Their high viscosities and solid state at room temperature serve as the principal barriers to their use in analytical chemistry. Carbon dioxide is the most widely utilised supercritical fluid because it is harmless, incombustible, readily available, and inexpensive. Its characteristics can be changed by adjusting the temperature and pressure, and it can be easily removed from the extract by lowering the temperature and pressure to room temperature. The main drawbacks of supercritical fluid technology are the high energy requirements and the requirement for complex equipment. We can therefore draw the conclusion that less toxic organic solvents should be the main focus of the quest for workable green (Figure 1) solvents. Application of biobased solvents of renewable origin, which are often easily biodegradable and less hazardous than most solvents derived from petroleum-related sources, is one of the main areas of green solvent development. This applies to both analytical chemistry and general green chemistry.

Results and Discussion

The prospective uses of these solvents in analytical chemistry have generally been disregarded, despite the fact that the practical application of biobased solvents in many fields of chemical technology appears to be on the horizon. The primary analytical chemistry uses for biobased reagents are spectrophotometric and electrochemical methods. In fact, as mentioned in, natural products can be employed as reagents in many analytical techniques either directly or with minimal preparation, but the fundamental challenge when using them is a tendency for greater limits of detection. The transition of chemical feedstocks from fossil fuels to [10-12] biobased ones is one of the current trends in chemical technology. A by-product of many sectors of industry and agriculture, biomass is valorized to produce useful chemicals or fuels. A larger variety of biomass feedstocks are being taken into consideration, and a larger portion of the biomass is being valorized, since industrial biomass valorization is currently undergoing rapid development. For analytical laboratories, the transition away from petroleum-based sources and toward renewable sources of materials also appears

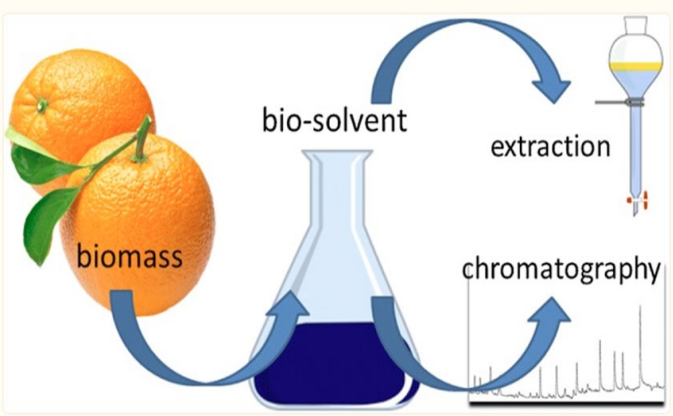

Figure 1: Graphical representation.

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inevitable. If petroleum-based solvents are no longer required for analytical chemistry is the key question that needs to be addressed in this regard. In other words, the issue is whether analytical chemistry can survive and even prosper in a biobased economy.

Biobased Versus Green Solvents

Methanol, ethanol, and acetonitrile are the typical solvents used as mobile phases in liquid chromatography. The latter is not a biosolvent and harms the environment more than the first two solvents combined. In most liquid-chromatographic separations, the use of methanol and ethanol along with the proper modifiers should yield adequate results. It is also possible to extract polar or moderately polar molecules from a variety of solid matrices using a variety of polar solvents. Finding appropriate nonpolar biobased solvents that can extract nonpolar analytes from water samples may be more difficult. Terpenes, which have a number of environmental problems, are the key possibilities in this field.

Conclusion

We may anticipate a rise in the usage of biobased organic solvents in analytical applications based on the factors mentioned above. However, (green) chemical technology, not analytical chemistry, is the driving force behind the development and use of new biosolvents. As a result, analysts who want to use new biobased solvents or create unique analytical methods based on them need to keep an eye on developments in green chemistry and technological separation methods. Fast computational approaches, such as quantitative structure-activity relationships, should be used to support studies of the greenness of biosolvents. Given the pressing need for such solvents, the hunt for water-insoluble, environmentally friendly biosolvents that are suitable for extractions is particularly crucial. There is growing interest in the development and study of biosolvent applications in analytical extractions and related domains. Alcohols, esters, and terpenes have primarily been the focus up to this point. Polar biosolvents, which are used as extraction solvents or mobile-phase components in liquid chromatography, seem to be able to meet some of the solvent requirements of analytical chemistry, but it is challenging to find nonpolar biosolvents that are suitable for extractions of lipophilic substances from polar media. The examination of biosolvents in this article demonstrates that many of them—especially the polar ones—can be used as greener solvents, but it also demonstrates that biobased solvents are not always environmentally friendly (this is true of terpenes, for instance).

Author Contributions

The diagnosis and treatment of this cat were handled exclusively by Jennifer Weng and Harry Cridge. This report was written by Jennifer Weng, and Harry Cridge gave it a critical appraisal. The final draught of the manuscript has received the approval of both Jennifer Weng and Harry Cridge.

Conflict of Interest

According to the authors, there are no conflicts of interest that might be thought to compromise the objectivity of the research presented.

Ethics Statement

The case described in this report was handled as part of the regular clinical caseload at the university teaching hospital; an IACUC or other ethical approval was not necessary. All facets of this patient's care had the owner's consent.

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