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Electromembrane Extraction

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Abstract

When creating new analytical procedures, green and ecologically friendly approaches are becoming increasingly important. Electromembrane extraction (EME) has helped to this by providing novel alternatives to commonly used plastic materials. Those formed from biopolymers (such as agarose or chitosan) have lately acquired prominence in EME because they are biodegradable and sustainable, which represents a significant benefit in terms of the environmental effect of these processes. This study will discuss the most recent improvements in EME techniques based on the use of sustainable biopolymer-based materials, including their characteristics and production, as well as their analytical application. Extraction devices and EME procedures will be thoroughly addressed, with an emphasis on their strengths and shortcomings, with the goal of developing analytical approaches for sample processing while contributing to their long-term viability [1].

Introduction

In this study, two ways of electromembrane extraction (EME) were investigated: one utilising deep eutectic solvents (DESs) as a liquid membrane and the other using gel electromembrane extraction (G-EME) based on solid agarose membrane. Both EME approaches use no organic solvents and are considered green methods. Unlike traditional EME, which relies on polypropylene membranes and organic extracting solvents, novel modes of EME rely on biodegradable membranes and aqueous extracting solutions. EME approaches based on novel designs adhere to green chemistry principles. Using high-performance liquid chromatography (HPLC) and a diode array detector, each mode of EME was assessed for the identification of polar and non-polar bases pharmaceuticals from human urine samples (DAD). EME with DES A proved effective for distinguishing polar and non-polar bases medicines throughout a wide polarity range. G-EME extraction recoveries were lower for all six pharmaceuticals examined than EME utilising DES A. When the two EME modes are compared, the analytical figures of merit reveal identical findings [2]. However, discrepancies in drug extraction recoveries by two EME modes were discovered, which are connected to membrane structural variances. Our results show that the changes in membrane characteristics employed in two EME modes, such as permeability, hydrophilicity, hydrophobicity, and the diversity of contacts, have an impact on extraction efficiency. The two EME modes ($r2 > 0.993$) demonstrated satisfactory linearity in the ranges of 16-100 and 19-100 g. L1 for G-EME and EME employing DES A, respectively. Furthermore, the detection limits (LODs) for G-EME and EME employing DES A were 19-32 and 19-29 g. L1, respectively [3].

Electromembrane extraction (EME) has made several breakthroughs as a sample preparation method within liquid phase microextraction (LPME) methods throughout the years, owing to its low solvent and sample consumption, in accordance with the trend towards green chemistry, as well as its excellent selectivity. Ionized analytes migrate from an aqueous sample to an acceptor solution in EME as a result of an electric field generated by an external power supply. During electrokinetic migration, the target chemicals travel through a supported liquid membrane (SLM), which is composed of a water-immiscible and hydrophobic solvent and is supported by various inert porous supporting materials, primarily polypropylene (PP)-based supports (including hollow fibers or flat sheet membranes). Furthermore, porous polymers with comparable properties, such as polyvinylidene fluoride (PVDF) or polytetrafluoroethylene (PTFE), have been widely employed [4]. The creation of increasingly effective and selective EME techniques is frequently a problem for researchers, and as a result, the support material commonly utilised for liquid membranes has grown in relevance in recent years. In this regard, some approaches have been introduced in which the traditional PP structure has been chemically modified, such as silver nanometallic-decorated PP hollow fibres or PP hollow fibre reinforced with carbon nanotubes, where the porous membrane plays an active role in the extraction process, thereby improving selectivity. Furthermore, novel materials of various compositions, including as polymer inclusion membranes (PIMs), nanostructured tissues, and polyacrylamide gels, have been produced and effectively employed in EME. Biopolymers, in particular, have lately emerged as an intriguing alternative to routinely used plastic supports. In this regard, agarose-based materials, whether films or gel membranes, are the most extensively employed in EME for a variety of applications, however other biopolymers, such as tragacanth gel membranes, have been described for comparable reasons [5].

Because proteins and lipids are plentiful in biological samples such as urine and plasma, analysing biological matrices is difficult. Proteins and lipids, on the other hand, stay in the samples and might produce an inaccuracy in an analytical signal. Any new version of sample preparation procedures, as well as their effective application, should be followed by the simplification of sample matrices. Membrane-based sample preparation procedures are gaining popularity because of their significance in sample cleaning. The water sample flows on one side (donor side) of the membrane towards the acceptor side, which can be an organic solvent or an aqueous solution in membrane-based techniques. As the first membrane-based micro extraction method, extraction driving force in hollow-fiber liquid-phase micro extraction (HF-LPME) is passive diffusion, and hence extraction kinetics is frequently poor due to the analyte sluggish diffusion rate across the

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membrane [6].

As a result, EME arose in 2006 to improve analytes diffusion rate and expedite extraction method, opening a new avenue for pharmaceutical analysis. EME allows for the determination of a wide spectrum of acidic and basic medicines from complicated matrices by employing organic extracting solvents immobilised in membrane pores. EME improves mass transfer by using applied voltage rather than passive diffusion, boosting analyte flow and reducing extraction time. Although EME by applied voltage has various advantages and intriguing characteristics, it is also connected with obstacles and restrictions. In general, analytes with log P values less than two are not successfully extracted when a pure solvent is utilised as a support liquid membrane (SLM). Lipophilic substances in biological samples also cause membrane pores to get clogged. This limitation is due to the nature of the EME membrane, which is typically constructed of polypropylene and is incompatible with polar chemicals and aqueous solutions [7].

The development of organic solvent-free techniques and the use of green materials is one of the principles of green chemistry. Green materials are frequently used in the development of innovative microextraction techniques due to their excellent features, which include cost-effective natural precursors and environmentally friendly synthesis procedures. As a result, green materials have received more attention in order to reduce chemical waste and achieve more safe techniques. Using biodegradable materials in membrane structures has emerged as a critical technique for improving EME performance in recent years. As a consequence of recent advancements, G-EME, which was released in 2017, has evolved into a tool capable of overcoming the aforementioned restrictions, and its position in micro extraction techniques is expected to increase over the next decade. Instead of polypropylene, agarose gel was employed as the membrane in G-EME. Because agarose gel is hydrophilic, polar ions may be readily transported from the sample solution to the acceptor solution. The process of making agarose gel is simple and involves dissolving agarose powder in water. G-EME is a green technique since it uses just agarose and water to make the membrane. Because of the agarose membrane's water compatibility, the time required to achieve a suitable separation is greatly reduced. Agarose is a biodegradable polymer with a hydrophilic network and variable pore size that is useful for separating polar substances. The extraction of tiny quantities of highly polar chemicals will be effective utilising an agarose gel-based membrane, with no worries about membrane pores being blocked by lipophilic matrices [8-10].

Polyphenols, on the other hand, are an essential class of chemicals renowned for their antioxidant capacity and ability to regulate plant development. They are derived mostly from natural sources such as plants and fruits. Numerous researches on the chitosan-polyphenol interaction have been published from various perspectives. Because of the strong biological activity of poly-phenolic chemicals (antioxidant, antiviral, or antibacterial, among others) and the adaptability of chitosan as a natural and biodegradable polymer, this issue is of significant interest in the food business and biomedicine. Polyphenol-modified chitosan-based polymers have been developed for use as bio-coatings, encapsulating agents, and bio-adsorbents. Insights into the chemical interaction between polyphenolic chemicals and chitosan have been thoroughly researched. Previously, evidence for the creation of a stable structure by hydrogen bonding in alkaline environments ($pH \geq 9$) was published. As a result, various phenolic compounds have been employed as chitosan crosslinking agents to impart antiviral and antibacterial capabilities to the bio-polymeric film.

Conclusion

A study was conducted to demonstrate the possible use of biodegradable materials as membranes in two EME modes. EME using DESs and agarose gel enabled the fabrication of membranes capable of hydrogen bonding and aromatic interactions. When compared to EME without a filter, both EME modes utilising Amicon ultra centrifugal filters performed better. Chitosan films have been employed effectively as a membrane for the EME of polyphenolic chemicals derived from various coffee and tea-based nutritional supplements. The absence of organic solvent during the extraction process, which is generally necessary in this sort of technology, is a significant novelty presented in this study. In this case, the bio-polymeric chitosan membrane serves as both a barrier between the donor and acceptor aqueous solutions and as an extracting material that actively participates in the EME.

References

1. Leung DYC, Wu X, Leung MKH (2010) A reviews on biodiesel production using catalyzed Tran's esterification. Appl Energy 87: 1083-1095.
2. Meher LC, Sagar DV, Naik SN (2006) Technical aspects of biodiesel production by Tran's esterification - A review. Renew Sustain Energy Rev 10: 248-268.
3. Anamika G, Saumya D, Mazumder A (2021) Updated Review on Ethno medicinal Plant Caryota urens. Int J Pharm Res 13: 101-105.
4. Zehr BE, Eckhoft SR, Singh SIC, Keeling PL (1995) Comparison of wet milling properties among maize inbred lines and their hybrids. Cereal Chem 72: 491-497.
5. Wijesinghe JAAC, Wickramasinghe I, Saranandha K (2015) Kithul Flour (Caryota urens) as a Potential Flour Source for Food Industry. Am J Food Technol 3: 10-18.
6. Toole BP (2001) Hyaluronan in morphogenesis. Semin Cell Dev Biol 12:79-87.
7. Allison D, Grande-Allen K (2006) Hyaluronan: a powerful tissue engineering tool. Biomaterials 12:2131-2140.
8. Philip JM, Mahalakshmi K (2019) Antimicrobial effect of three Indian medicinal plant extracts on common denture plaque bacteria. Drug Discov Today 11(3): 584-586.
9. Geetha S, Vasuki R (2019) Anticancer activity of Cissus quadrangularis. Int j eng innov technol 8: 603- 605.
10. Anbuselvi S, Roshini Esther A, Punithavathy R (2019) In-vitro anti-urolithiatic activity of Theriophonum minutum and Remusatia vivipara. Int J Recent Technol Eng 8: 3088-3091.