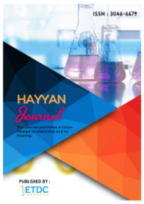

HAYYAN JOURNAL
Vol. 3 No. 2, June 2026, page. 37-45
ISSN: 3046-6679

Progress in Electrochemical MIP Sensors for Detection of Bisphenol A: A Mini review

Andi Eka Kartika[1*], Andi Bulqiah Nur Bunyamin[1]

[1]Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar,
Makassar, South Sulawesi

Corresponding Address: andi.eka.kartika@unm.ac.id

Received: April 21, 2026 *Accepted: May 23, 2026* *Online Published: June 05, 2026*

ABSTRACT

Bisphenol A (BPA) is an endocrine-disrupting chemical widely used in the production of polycarbonate plastics and epoxy resins, raising concerns regarding its migration into food, beverages, and the environment. This mini-review summarizes recent advances in molecularly imprinted polymer (MIP)-based electrochemical sensors for BPA detection, with emphasis on recent developments in sensor fabrication, nanomaterial modification, and analytical performance. The review discusses MIP synthesis strategies, sensor platforms, nanomaterial modifications, and analytical performance. Recent studies have demonstrated that MIP-based electrochemical sensors can achieve highly sensitive BPA detection with limits of detection ranging from 0.03 pM to 52 nM, wide linear ranges, and successful application in real samples such as drinking water, milk, and packaged beverages. The incorporation of nanomaterials, including graphene, carbon nanotubes, and gold nanoparticles, has significantly improved electron transfer, sensitivity, and selectivity. Despite these advances, challenges related to long-term stability, reproducibility, template removal efficiency, and matrix interference remain. Overall, MIP-based electrochemical sensors represent a promising platform for rapid, selective, and cost-effective BPA monitoring in environmental and food safety applications.

Keywords: Bisphenol A, molecularly imprinted polymer, electrochemical sensor, BPA detection

I. INTRODUCTION

Bisphenol A (BPA) is a synthetic chemical compound widely used as a raw material in the production of polycarbonate plastics and epoxy resins. This compound is commonly found in various everyday products such as plastic bottles, food containers, can coatings, medical equipment, and food packaging. The extensive use of BPA causes it to be easily released into the environment or migrate into food and beverages, especially under high temperatures or repeated use. The presence of BPA in the environment and food products has become a major concern because it may cause negative impacts on human health (Vilarinho et al., 2019).

BPA is known as an endocrine disrupting chemical (EDC) that can interfere with the hormonal system in the human body. Long-term exposure to BPA has been associated with various health disorders, including reproductive disorders, obesity, diabetes, neurodevelopmental disorders, and an increased risk of cardiovascular diseases and certain cancers. Therefore, monitoring BPA levels in environmental and food samples is very important to ensure public safety and health (vom Saal et al., 2012)

Various analytical methods have been used to detect BPA, such as high-performance liquid chromatography (HPLC) (Pop et al., 2024), gas chromatography-mass spectrometry (GC-MS) (Bodur et al., 2020) and spectrophotometry (Nugroho et al., 2019). Although these methods provide good sensitivity and accuracy, their application often requires expensive instruments, complicated sample preparation, and relatively long analysis times (Szubartowski & Tuzimski, 2023). In recent years, electrochemical sensors have attracted considerable attention because of their advantages, including high sensitivity, rapid response, low cost, and simpler analytical procedures.

One of the most widely used approaches in BPA sensor development is molecularly imprinted polymer (MIP). MIP is a synthetic polymer that contains specific cavities corresponding to the shape and size of the target molecule, thereby enhancing sensor selectivity. MIP technology offers several advantages, such as good chemical stability, resistance to environmental conditions, and high molecular recognition capability (Li et al., 2024). In addition, the combination of MIP with various nanomaterials such as graphene, carbon nanotubes, and metal nanoparticles has been extensively explored to improve sensor sensitivity and performance (Ben Messaoud et al., 2018; Han et al., 2023).

Despite the significant progress in the development of molecularly imprinted polymer (MIP)-based electrochemical sensors for bisphenol A (BPA) detection**,** comprehensive reviews of recent advances remain limited. Previous studies have primarily focused on specific sensor designs, nanomaterial modifications, or analytical performance without systematically examining the relationships between imprinting strategies, sensing materials, and sensor performance. Furthermore, the rapid development of novel nanocomposites and fabrication techniques has resulted in fragmented information, making it difficult to identify current trends, advantages, limitations, and future research directions. Based on these developments, MIP-based sensors have demonstrated great potential for the rapid, sensitive, and selective detection of BPA, with recent studies reporting significant improvements in sensor performance through advanced material modifications and electrochemical analysis techniques. Therefore, this mini-review summarizes recent advances in MIP-based sensors for BPA detection, including analytical performance, current challenges, and future prospects for their development and practical applications.

.

II. REVIEW METHOD

This mini-review was conducted through a literature search using several scientific databases, including Scopus, ScienceDirect, PubMed, and Google Scholar. The search employed combinations of the keywords *“bisphenol A”*, *“BPA”*, *“molecularly imprinted polymer”*, *“MIP”*, *“electrochemical sensor”*, *“electrochemical detection”*, and *“voltammetry”*. The literature search primarily focused on recent publications, while selected earlier studies were included to provide fundamental background on BPA and MIP technology.

The inclusion criteria consisted of original research articles and review papers reporting the fabrication, characterization, modification, or analytical performance of MIP-based electrochemical sensors for BPA detection. Studies unrelated to BPA, non-electrochemical sensing approaches, conference abstracts, patents, and duplicate publications were excluded. The selected articles were screened based on their relevance to sensor design, sensing materials, detection mechanisms, analytical performance, and practical applications. The retrieved literature was then critically analyzed and summarized to identify recent advances, current challenges, and future perspectives in the development of MIP-based electrochemical sensors for BPA detection.

III. BISPHENOL A (BPA)

Bisphenol A (BPA) is a synthetic organic compound containing two phenol groups that is widely used in the production of polycarbonate plastics and epoxy resins. BPA possesses transparent, strong, and heat-resistant properties, making it extensively applied in various industrial and household products. This compound is commonly found in plastic bottles, food containers, can coatings, water pipes, and thermal paper. Due to its widespread use, BPA has become one of the most frequently detected chemical contaminants in the environment and food products (Czarny-Krzymińska et al., 2023).

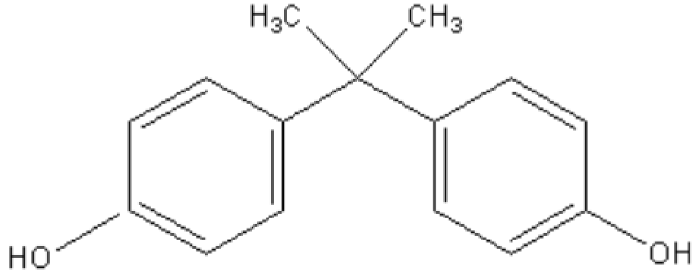

Figure 1. Structure of Bisphenol A

The presence of BPA in the environment mainly originates from the migration of plastic materials, industrial waste, and the degradation of polycarbonate-based products. BPA can leach into food or beverages due to heating, ultraviolet light exposure, or repeated use. Several studies have reported the presence of BPA in river water, wastewater, sediments, milk, canned foods, and packaged beverages. BPA contamination in the environment and food has become a serious concern because this compound is persistent and can accumulate in living organisms (Stevens et al., 2024).

BPA is classified as an endocrine disrupting chemical (EDC) that can interfere with the hormonal system in the body. The structural similarity of BPA to the hormone estrogen allows this compound to bind to hormone receptors and affect various biological processes. Long-term exposure to BPA has been associated with reproductive disorders, obesity, diabetes, neurodevelopmental disorders, and an increased risk of cardiovascular diseases and certain cancers. Therefore, monitoring BPA levels in environmental and food samples is essential to support food safety and public health (Cimmino et al., 2020).

IV. MOLECULARLY IMPRINTED POLYMER (MIP)

Molecularly imprinted polymer (MIP) is a synthetic polymeric material designed to possess specific molecular recognition capability toward a target compound. This technology was developed by mimicking the molecular recognition mechanisms found in biological systems, such as antibodies and enzymes. In the synthesis process of MIP, the target molecule is used as a template that interacts with functional monomers before polymerization takes place. After the polymer is formed, the template molecule is removed, resulting in the formation of specific cavities that possess shapes, sizes, and functional groups complementary to the target molecule (Saylan et al., 2019).

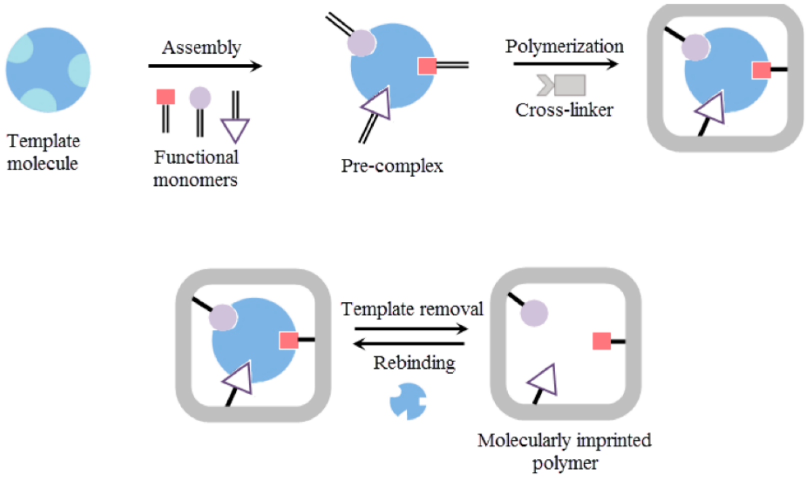

Figure 1. Schematic illustration of molecularly imprinted polymer (MIP) synthesis (Saylan et al., 2019)

MIP synthesis generally involves several main stages, namely the formation of a complex between the template and functional monomer, polymerization, crosslinking, and template extraction. In the initial stage, a template molecule such as Bisphenol A (BPA) is mixed with functional monomers to form interactions through hydrogen bonding, electrostatic interactions, or hydrophobic forces. Subsequently, crosslinkers and initiators are added to form a stable polymer structure through the polymerization process. After the polymer is formed, the template molecules are extracted using specific solvents, leaving behind selective cavities capable of recognizing BPA molecules selectively (Önal Acet et al., 2024).

In sensor development, various MIP synthesis methods have been employed, including bulk polymerization, precipitation polymerization, suspension polymerization, and electropolymerization (Önal Acet et al., 2024). Electropolymerization is widely applied in electrochemical sensors because the polymer film can be directly formed on the electrode surface with good thickness control. In addition, this method is relatively simple, rapid, and capable of producing homogeneous MIP layers, thereby enhancing sensor sensitivity (Dykstra et al., 2022).

In the development of sensors for Bisphenol A (BPA) detection, various types of monomers and supporting materials have been utilized to improve sensor selectivity and sensitivity. Recent studies have demonstrated that the selection of MIP synthesis components greatly influences the analytical performance of the sensor, including detection limit, sensitivity, and selectivity toward BPA. Table 1 presents several main components used in MIP synthesis for BPA detection based on recent studies.

Table 1. Components used in BPA-imprinted polymer synthesis for sensor applications

Functional Monomer	**Crosslinker**	**Initiator**	**Synthesis Method**	**Sensor Platform**	**Ref**
acrylonitrile	EGDMA	AIBN	bulk polymerization	MIP/N-MWCNT/CPE	(Xu et al., 2022)
2-Hydroxyethyl methacrylate (HEMA)	EGDMA	-	bulk polymerization	MIP/MWCNT/CPE	(Metwally et al., 2022)

p-aminobenzoic acid	-	-	electropolymerization	MIP/ERGO	(Han et al., 2023)
Ferrocenylmethyl methacrylate and 4-vinylpyridine	EGDMA	AIBN	precipitation polymerization	MIP/SPCE	(Ekomo et al., 2018)
MAA and 4-VPy	EGDMA	AIBN	bulk polymerization	MIP/GCE	(Anirudhan et al., 2018)

In addition to having high selectivity, MIP also offers several other advantages, including good chemical stability, resistance to extreme temperature and pH conditions, relatively low production cost, and easier preparation compared to biological materials. Therefore, MIP has become one of the most promising materials for the development of rapid, sensitive, and selective BPA sensors for environmental and food safety applications (Kadhem et al., 2021).

V. MIP-BASED SENSORS FOR BPA DETECTION

The development of molecularly imprinted polymer (MIP)-based sensors for Bisphenol A (BPA) detection has increased significantly in recent years. MIP-based sensors have been widely developed because they possess high selectivity toward target molecules, even in complex sample matrices. In addition, the combination of MIP with various modern analytical techniques can improve the sensitivity and accuracy of BPA detection at low concentrations (Hamed & Li, 2022).

Various studies have also reported the use of nanomaterials to enhance the performance of MIP-based sensors. Materials such as graphene, carbon nanotubes (CNTs), gold nanoparticles (AuNPs), and metal oxide nanoparticles are widely utilized because they can increase the active surface area, conductivity, and electron transfer on the sensor surface. The combination of MIP and nanomaterials produces sensors with higher sensitivity, lower detection limits, and better stability compared to conventional sensors (Niu et al., 2013; Xu et al., 2022).

In addition to sensitivity, the applicability of MIP-based BPA sensors to real samples is also an important factor in sensor development. Several studies have successfully applied these sensors to water samples, milk, packaged beverages, and other food products, as shown in Table 2.

Table 2. Recent MIP-based sensors for BPA detection

Sensor Platform	**Linear Range**	**LOD**	**Real Sample**	**Reference**
MWCNT-MIP/GCE	0.2 – 45 pM	0.03 pM	River water	(Liu et al., 2019)
MWCNT-MIP/GCE	400 µM – 0.10 nM	0.02 nM	Extract of baby milk bottles	(Anirudhan et al., 2018)
MIP/CNTS-Au NPs/BOMC/GCE	0.01 – 10 µM	5 nM	Milk sample	(Hu et al., 2018)
MIP/ERGO/GCE	750 and 0.5 nM	0.2 nM	Drinking water, bottled beverages made of polycarbonate, cow milk	(Karthika et al., 2021)
MIP/MWCNT/CPE	$1 \times 10^{-9} - 1 \times 10^{-4}$ M	0.08×10^{-9} M	Tap water, water stored in baby bottles, household filtered water, and soft drink samples	(Metwally et al., 2022)

MIPs @ QDs-MWCNTs	0.05 – 50 nmol L^{-1}	0.015 nmol L^{-1}	Tap water, river water near the school, and drinking water	(Zhang et al., 2021)
MIP@Au/Au/GCE	0.5 – 100 μM	52 nM	food samples	(Han et al., 2023)

A comparison of the sensor platforms presented in Table 2 reveals notable differences in analytical performance and practical applicability. Among the reported sensors, the MWCNT-MIP/GCE developed by Liu et al., (2019) achieved the lowest limit of detection (0.03 pM), indicating the significant contribution of multi-walled carbon nanotubes to signal amplification and electron transfer efficiency. Similarly, MIP sensors incorporating carbon nanomaterials, such as MWCNTs and quantum dot-modified MWCNTs, generally exhibited lower detection limits than conventional MIP electrodes, highlighting the importance of nanomaterial-assisted conductivity enhancement. In contrast, the MIP@Au/Au/GCE sensor reported by Han et al., (2023) showed a comparatively higher LOD (52 nM) but offered the advantages of facile fabrication and enhanced surface recognition through gold nanoparticle modification.

Differences in linear detection ranges also reflect the suitability of each platform for specific applications. Sensors based on MWCNT-MIP and MIP/MWCNT composites generally provided wider working ranges, making them suitable for monitoring BPA across varying concentration levels. Meanwhile, graphene-based platforms such as MIP/ERGO/GCE demonstrated balanced performance in terms of sensitivity, selectivity, and applicability to diverse sample matrices. Regarding practical applications, most sensors were successfully validated using environmental water samples, while only a limited number were tested in more complex matrices such as milk, beverages, and food products. This indicates that although excellent analytical performance has been achieved under laboratory conditions, broader validation in complex real-world samples remains necessary to demonstrate the robustness and practical applicability of MIP-based BPA sensors.

VI. RECENT PROGRESS AND CHALLENGES

The development of molecularly imprinted polymer (MIP)-based sensors for Bisphenol A (BPA) detection continues to advance, particularly through the incorporation of nanomaterials into sensor systems. Various nanomaterials such as graphene, carbon nanotubes (CNTs), gold nanoparticles (AuNPs), and metal oxide nanoparticles have been widely utilized to improve sensor performance. These materials are capable of increasing the active surface area, accelerating electron transfer, and enhancing sensor sensitivity and stability. The combination of MIP and nanomaterials has also been reported to provide lower detection limits, enabling the detection of BPA at trace concentrations (Metwally et al., 2022; Niu et al., 2013).

In addition to nanomaterial utilization, the development of portable sensors has become one of the major focuses in MIP-based BPA sensor research. Portable sensors are developed to provide analytical methods that are more practical, rapid, and easy to use in the field without requiring complex laboratory instruments. The use of screen-printed carbon electrodes (SPCEs) and portable electrochemical devices enables real-time BPA detection using small sample volumes. These developments demonstrate the great potential of MIP-based sensors for direct environmental monitoring and food safety applications (Ekomo et al., 2018).

Despite significant progress, MIP-based sensors still face several challenges and limitations. One of the major challenges is that MIP synthesis sometimes requires relatively long processing times and complex optimization conditions to produce homogeneous binding sites. In addition, incomplete template removal may reduce sensor selectivity. Some sensors also still experience electrode surface fouling, low long-term stability, and poor reproducibility of synthesis among different studies (Li et al., 2024).

Besides technical limitations, the application of MIP sensors to real samples still faces challenges due to interference from other compounds in complex matrices. Therefore, the development of simpler synthesis methods, the use of more stable materials, and the integration of portable sensor technologies are continuously being pursued to improve the performance and practical applications of MIP-based BPA sensors in the future (Li et al., 2024).

VII.CONCLUSION

Berikut versi kesimpulan yang lebih tajam dan secara langsung menjawab komentar reviewer:

VI. CONCLUSION

Molecularly imprinted polymer (MIP)-based electrochemical sensors have demonstrated considerable potential for the selective and sensitive detection of Bisphenol A (BPA). The integration of MIP technology with electrochemical sensing platforms and nanomaterials, including graphene, carbon nanotubes, gold nanoparticles, and metal oxides, has significantly enhanced analytical performance by lowering detection limits, expanding linear ranges, and improving sensitivity and stability. Furthermore, these sensors have shown successful applicability in various real samples, such as drinking water, milk, and packaged beverages.

Among the available fabrication approaches, electropolymerization remains one of the most attractive methods due to its simplicity, rapid preparation, and precise control of polymer film formation on electrode surfaces. In addition, the emergence of portable electrochemical devices and screen-printed electrodes has expanded the potential for rapid, on-site BPA monitoring in environmental and food safety applications.

Despite these advances, several challenges remain, including limited reproducibility of MIP fabrication, incomplete template removal, electrode fouling, and insufficient long-term stability evaluation. Future research should focus on the standardization of MIP fabrication protocols**,** long-term stability and reusability studies**,** validation across diverse and complex sample matrices**,** and the integration of MIP sensors with portable and miniaturized sensing platforms**.** Addressing these challenges will be essential for improving reliability, facilitating large-scale application, and accelerating the commercialization of MIP-based electrochemical sensors for BPA monitoring.

VIII. REFERENCES

Anirudhan, T. S., Athira, V. S., & Chithra Sekhar, V. (2018). Electrochemical sensing and nano molar level detection of Bisphenol-A with molecularly imprinted polymer tailored on multiwalled carbon nanotubes. *Polymer, 146,* 312–320. https://doi.org/10.1016/j.polymer.2018.05.052

Ben Messaoud, N., Ait Lahcen, A., Dridi, C., & Amine, A. (2018). Ultrasound assisted magnetic imprinted polymer combined sensor based on carbon black and gold nanoparticles for selective and sensitive electrochemical detection of Bisphenol A. *Sensors and Actuators B: Chemical*, *276,* 304–312. https://doi.org/10.1016/j.snb.2018.08.092

Bodur, S., Erarpat, S., Dalgıç Bozyiğit, G., Selali Chormey, D., Öz, E., Özdoğan, N., &

Bakırdere, S. (2020). A sensitive determination method for trace bisphenol A in bottled water and wastewater samples: Binary solvent liquid phase microextraction-quadrupole isotope dilution-gas chromatography-mass spectrometry. *Microchemical Journal*, *159*, 105532. https://doi.org/10.1016/j.microc.2020.105532

Cimmino, I., Fiory, F., Perruolo, G., Miele, C., Beguinot, F., Formisano, P., & Oriente, F. (2020). Potential Mechanisms of Bisphenol A (BPA) Contributing to Human Disease. *International Journal of Molecular Sciences*, *21*(16), 5761. https://doi.org/10.3390/ijms21165761

Czarny-Krzymińska, K., Krawczyk, B., & Szczukocki, D. (2023). Bisphenol A and its substitutes in the aquatic environment: Occurrence and toxicity assessment. *Chemosphere*, *315*, 137763. https://doi.org/10.1016/j.chemosphere.2023.137763

Dykstra, G., Reynolds, B., Smith, R., Zhou, K., & Liu, Y. (2022). Electropolymerized Molecularly Imprinted Polymer Synthesis Guided by an Integrated Data-Driven Framework for Cortisol Detection. *ACS Applied Materials & Interfaces*, *14*(22), 25972–25983. https://doi.org/10.1021/acsami.2c02474

Ekomo, V. M., Branger, C., Bikanga, R., Florea, A.-M., Istamboulie, G., Calas-Blanchard, C., Noguer, T., Sarbu, A., & Brisset, H. (2018). Detection of Bisphenol A in aqueous medium by screen printed carbon electrodes incorporating electrochemical molecularly imprinted polymers. *Biosensors and Bioelectronics*, *112*, 156–161. https://doi.org/10.1016/j.bios.2018.04.022

Hamed, E. M., & Li, S. F. Y. (2022). Molecularly imprinted polymers-based sensors for bisphenol-A: Recent developments and applications in environmental, food and biomedical analysis. *Trends in Environmental Analytical Chemistry*, *35*, e00167. https://doi.org/10.1016/j.teac.2022.e00167

Han, E., Pan, Y., Li, L., & Cai, J. (2023). Bisphenol A detection based on nano gold-doped molecular imprinting electrochemical sensor with enhanced sensitivity. *Food Chemistry*, *426*, 136608. https://doi.org/10.1016/j.foodchem.2023.136608

Hu, X., Feng, Y., Wang, H., Zhao, F., & Zeng, B. (2018). A novel bisphenol A electrochemical sensor based on a molecularly imprinted polymer/carbon nanotubes-Au nanoparticles/boron-doped ordered mesoporous carbon composite. *Analytical Methods*, *10*(37), 4543–4548. https://doi.org/10.1039/C8AY01611A

Kadhem, A. J., Gentile, G. J., & Fidalgo de Cortalezzi, M. M. (2021). Molecularly Imprinted Polymers (MIPs) in Sensors for Environmental and Biomedical Applications: A Review. *Molecules*, *26*(20), 6233. https://doi.org/10.3390/molecules26206233

Karthika, P., Shanmuganathan, S., Viswanathan, S., & Delerue-Matos, C. (2021). Molecularly imprinted polymer-based electrochemical sensor for the determination of endocrine disruptor bisphenol-A in bovine milk. *Food Chemistry*, *363*, 130287. https://doi.org/10.1016/j.foodchem.2021.130287

Li, Y., Luo, L., Kong, Y., Li, Y., Wang, Q., Wang, M., Li, Y., Davenport, A., & Li, B. (2024). Recent advances in molecularly imprinted polymer-based electrochemical sensors. *Biosensors and Bioelectronics*, *249*, 116018. https://doi.org/10.1016/j.bios.2024.116018

Liu, B., Yan, J., Wang, M., & Wu, X. (2019). Molecularly imprinted electrochemical sensor for the detection of bisphenol A. *International Journal of Electrochemical Science*, *14*(4), 3610–3617. https://doi.org/10.20964/2019.04.58

Metwally, M. G., Shehab, O. R., Ibrahim, H., & El Nashar, R. M. (2022). Electrochemical detection of Bisphenol A in plastic bottled drinking waters and soft drinks based on molecularly imprinted polymer. *Journal of Environmental Chemical Engineering*, *10*(3), 107699. https://doi.org/10.1016/j.jece.2022.107699

Niu, X., Yang, W., Wang, G., Ren, J., Guo, H., & Gao, J. (2013). A novel electrochemical sensor of bisphenol A based on stacked graphene nanofibers/gold nanoparticles composite modified glassy carbon electrode. *Electrochimica Acta*, *98*, 167–175. https://doi.org/10.1016/j.electacta.2013.03.064

Nugroho, B., Pramudya, Y., & Widodo, W. (2019). The Content Analysis of Bisphenol A (BPA) on Water in Plastic Glass with Varying Temperatures and Contact Times using UV-VIS Spectrophotometer. *Indonesian Review of Physics*, *1*(2), 27. https://doi.org/10.12928/irip.v1i2.263

Önal Acet, B., İnanan, T., Salieva, K., Borkoev, B., Odabaşı, M., & Acet, Ö. (2024). Molecular imprinted polymers: important advances in biochemistry, biomedical and biotechnology. *Polymer Bulletin*, *81*(12), 10439–10459. https://doi.org/10.1007/s00289-024-05238-5

Pop, C.-E., Miu, B. A., Németh, D., Wolff, R., Mihăilescu, D. F., Avramescu, S. M., & Mernea, M. (2024). Bisphenol A analysis and quantification inconsistencies via HPLC-UV: a systematic review with technical notes. *Discover Applied Sciences*, *6*(4), 171. https://doi.org/10.1007/s42452-023-05617-z

Saylan, Y., Akgönüllü, S., Yavuz, H., Ünal, S., & Denizli, A. (2019). Molecularly Imprinted Polymer Based Sensors for Medical Applications. *Sensors*, *19*(6), 1279. https://doi.org/10.3390/s19061279

Stevens, S., Bartosova, Z., Völker, J., & Wagner, M. (2024). Migration of endocrine and metabolism disrupting chemicals from plastic food packaging. *Environment International*, *189*, 108791. https://doi.org/10.1016/j.envint.2024.108791

Szubartowski, S., & Tuzimski, T. (2023). A Fast Method for Determination of Seven Bisphenols in Human Breast Milk Samples with the Use of HPLC-FLD. *Molecules*, *28*(3), 1432. https://doi.org/10.3390/molecules28031432

Vilarinho, F., Sendón, R., van der Kellen, A., Vaz, M. F., & Silva, A. S. (2019). Bisphenol A in food as a result of its migration from food packaging. *Trends in Food Science & Technology*, *91*, 33–65. https://doi.org/10.1016/j.tifs.2019.06.012

vom Saal, F. S., Nagel, S. C., Coe, B. L., Angle, B. M., & Taylor, J. A. (2012). The estrogenic endocrine disrupting chemical bisphenol A (BPA) and obesity. *Molecular and Cellular Endocrinology*, *354*(1–2), 74–84. https://doi.org/10.1016/j.mce.2012.01.001

Xu, R., Qian, X., Zhang, Z., Yuan, F., Song, Y., Liu, J., Zhang, Q., & Wei, J. (2022). A molecularly Imprinted Electrochemical Sensor Based on N-MWCNT/CPE for Highly Sensitive and Selective Detection of Bisphenol A. *International Journal of Electrochemical Science*, *17*(5), 220536. https://doi.org/10.20964/2022.05.06

Zhang, Y., Zhang, W., Zhang, L., Song, G., Wang, N., Xu, W., & Huang, W. (2021). A molecularly imprinted electrochemical BPA sensor based on multi-walled carbon nanotubes modified by CdTe quantum dots for the detection of bisphenol A. *Microchemical Journal*, *170*, 106737. https://doi.org/10.1016/j.microc.2021.106737