OPTIMIZATION OF MOLECULAR IMPRINTED POLYMER SYNTHESIS FOR EXTRACTION OF QUERCETIN

Sibel Barbaros Djebbar, PhD Candidate[1]; Tuba Gözet, PhD[1]
[1]University of Altinbas

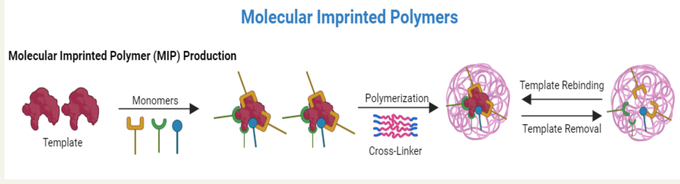
INTRODUCTION

Quercetin is a polyphenol compound and categorized as a flavonol. Quercetin exhibits therapeutic and preventable potential against various diseases such as cancer, osteoporosis, asthma, Alzheimer, diabetes and dermatological disorders. Thanks to its properties, QCT is widely used in the medical and pharmaceutical fields.

Molecularly imprinted polymers (MIPs) are attractive artificial receptors which can specifically adsorb the target molecule. For preparation of MIPs, covalent or non-covalent interactions are formed between template and monomers before polymerization. By adding a cross-linking agent, three-dimensional network of polymer is produced. After polymerization, template is removed by chemical reaction or extraction. The resulting MIP includes microcavities with a specific structure which are in agreement with the template molecule in both shape and size.

The traditional procedures used for the separation and extraction of QCT from the plant extracts were always time-consuming and solvent-dependent. Therefore, the elaboration of a selective, fast, simple and accurate method for the extraction and detection of QCT is highly desired. Molecularly imprinted polymers (MIPs) possessing unique advantages in terms of its specificity and selectivity might present a desirable approach.

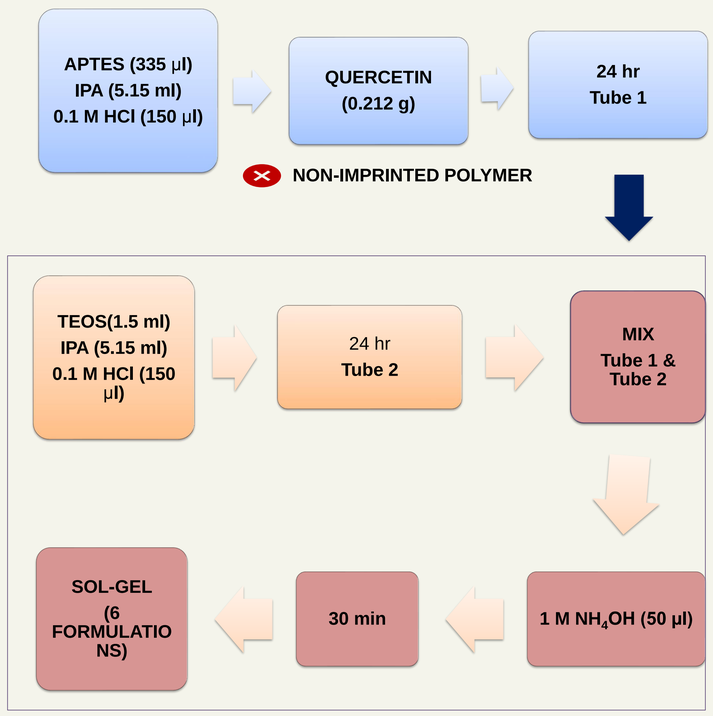
Combination of MIPs with SPME technique enhances the efficiency of the extraction process. SPME is a simple method which reduces the consumption of organic solvents, amount of extracting phase and sample, also has a high selectivity in combination with the MIPs. Therefore, the MIP-SPME was used to measure of quercetin.



In this study, molecularly imprinted polymers (MIPs) with different formulations were synthesized with a sol-gel polymerization mechanism at room temperature using quercetin as the template, 3-aminopropyltriethoxysilane (APTES) as the functional monomer, and tetraethoxysilane (TEOS) as the cross-linker. The preparation of MIPs for extraction via sol-gel polymerization mechanism using APTES as the functional monomer and TEOS as the cross-linker was optimized. Non-imprinted polymers (NIPs) were synthesized without a template for each MIP formulation and used for comparison in the extraction of plant samples. UV-VIS Spectroscopy was used to measure the removal of Quercetin percentage.

METHODS AND MATERIALS

SYNTHESIS OF MOLECULAR IMPRINTED (NON-IMPRINTED) POLYMER



Removal of the template from sol–gel MIP sorbent

Following the preparation of sol–gel MIP sorbent, the template (Quercetin) has to be quantitatively removed from the polymer particles.		
Methanol	Methanol:Asetic Asid (9:1)	Methanol:Asetic Asid (8:2)

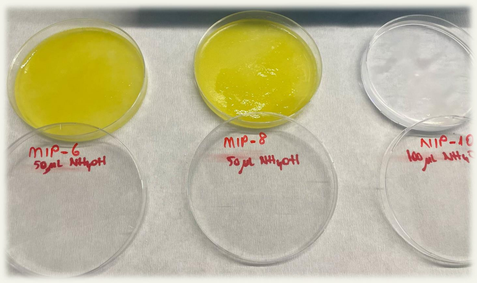


Figure 1. MIPs and NIP before drying

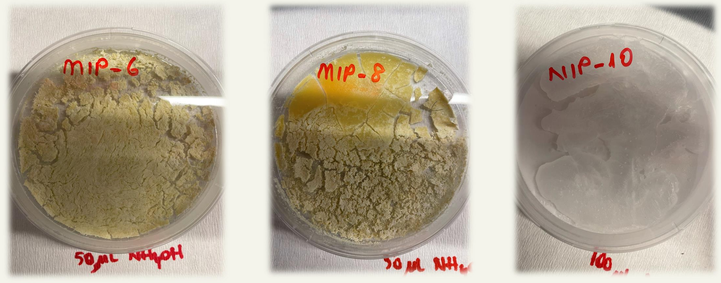


Figure 2. MIP and NIP after drying

RESULTS

UV-Vis spectroscopy measurements were made at 372 nm for 6 polymers obtained in different formulations. Removal of quercetin was compared by using 3 different solvent types. Firstly, Methanol was used for the removal of the template from the polymer. And then Methanol:ACN (9:1) and Methanol:ACN (8:1) were used. According to the calibration curve (Chart 1) obtained with standard quercetin solutions, removal template amount was calculated.

Results of measurements are shown in Chart 2.

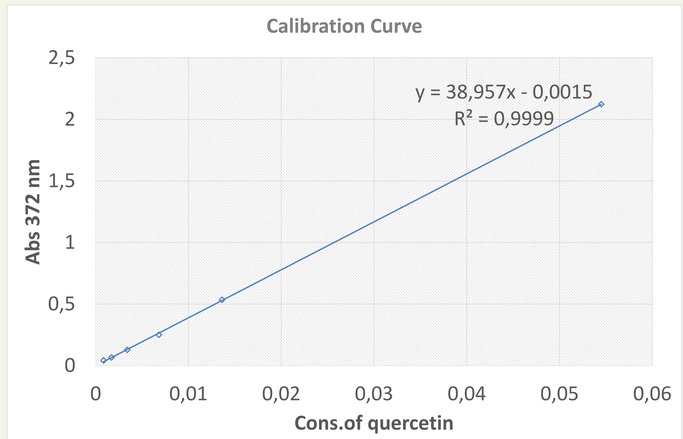


Chart 1. Calibration Curv of standart quercetin solutions at 372 nm

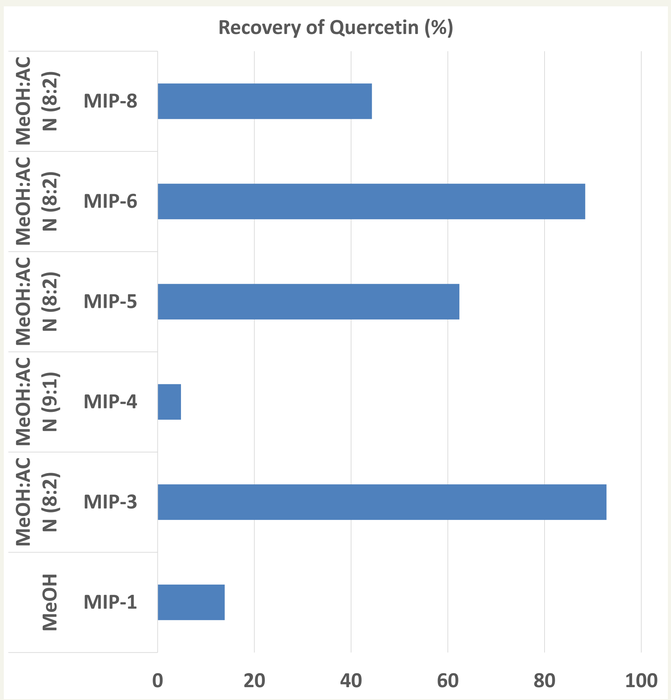


Chart 2. Removal amount of quercetin template from polymers with different solvents

CONCLUSIONS

In this study, molecularly imprinted polymers (MIPs) with different formulations were synthesized with a sol-gel polymerization mechanism at room temperature using quercetin as the template, 3-aminopropyltriethoxysilane (APTES) as the functional monomer, and tetraethoxysilane (TEOS) as the cross-linker. The preparation of MIPs for extraction via sol-gel polymerization mechanism using APTES as the functional monomer and TEOS as the cross-linker was optimized. Non-imprinted polymers (NIPs) were synthesized without a template for each MIP formulation and used for comparison in the extraction of plant samples. UV-VIS Spectroscopy was used to measure the removal of Quercetin percentage.

DISCUSSION

When the polymers in different formulations obtained by the sol-gel method were compared, it was seen that the most optimal polymer was obtained by using 2.12 mg Quercetin.

Although the most useful method was soxhlet extraction during the removal phase, the most useful method was the combination of ultrasonic bath and centrifuge.

It was proven by UV-Vis measurements that the washing solvent that provided the most removal was Methanol:Acetic Acid (8:2).

FUTURE WORK

Extraction experiments will be carried out using the MISPE method through the SPE vacuum manifold apparatus with the obtained molecularly imprinted polymers and the unimprinted (NIP) polymers made for their comparison, and characterization studies will be carried out with SEM analysis of the polymers.The first extraction experiments will be carried out with standard Quercetin solutions using imprinted (MIP) and unimprinted (NIP) polymers, the elutions obtained will be measured by HPLC and selectivity studies will be carried out. Quercetin quantity analysis will then be performed in hawthorn and quercetin capsules.

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CONTACT

<Sibel Barbaros Djebbar>
<Altınbas University>
Email: sibel.barbaros@altinbas.edu.tr
Phone: +905343732966

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