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MDPI

Synthesis and characterization of magnetic molecular imprinted polymer (MMIP) for extraction of vitamin B12 from milk

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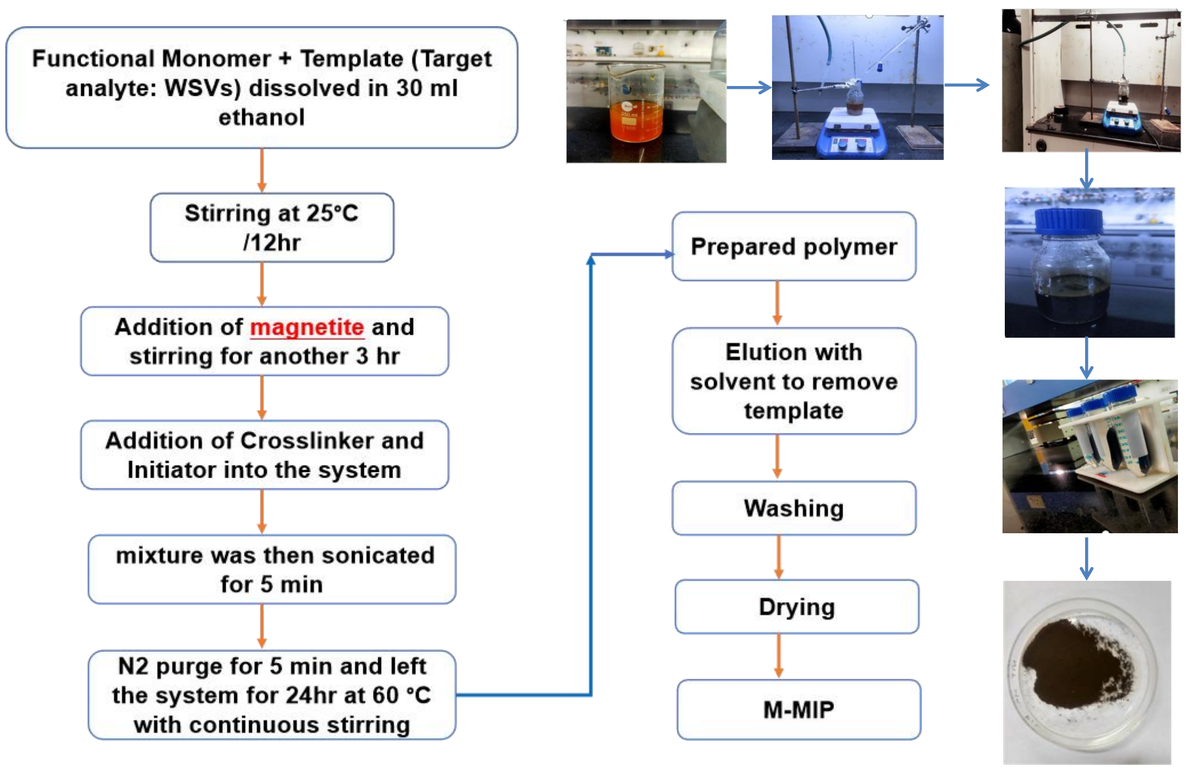
INTRODUCTION & AIM

- Quantifying low levels of vitamin B12 in milk (0.5 µg/100 mL) requires selective extraction, currently using costly immunoaffinity SPE columns
- Molecularly imprinted polymer (MIP)-based SPE offers a cost-effective alternative
- MIPs are synthetic polymers with selective recognition sites, formed using a template, monomer, crosslinker, and initiator
- The proportions of these components are crucial for optimizing binding efficiency
- This study evaluates varying MIP ratios to improve binding capacity and selectivity, with the best MIPs used for vitamin B12 extraction from milk

METHOD



Different ratios of Template (T), Functional Monomer (FM), Crosslinker (C), and Initiator (I) for the preparation of imprinted polymer

Magnetic molecular imprinted polymer (MMIP)	Functional monomer (MAA): Template (Cyanocobalamine)	Crosslinker (EGDMA): Functional monomer (MAA)	Functional monomer (MAA): Initiator (AIBN)
MMIP 1	2	5	16
MMIP 2	4	5	16
MMIP 3	6	5	16
MMIP 4	4	10	16
MMIP 5	4	10	5

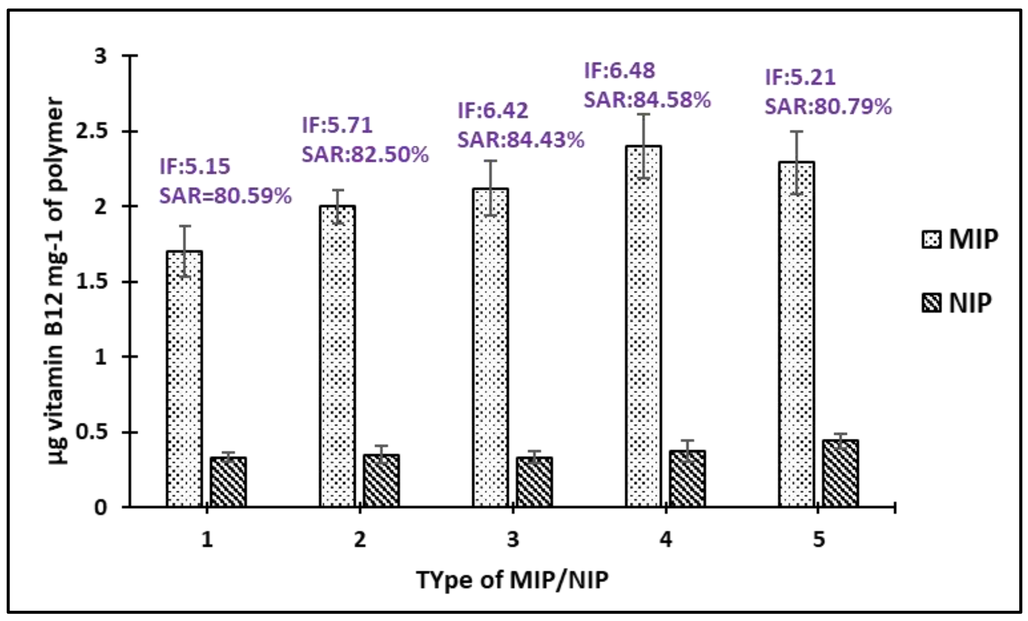
$$\textbf{Binding Capacity}\ (\mu g\ \textbf{vitamin B12 per mg of polymer}) = \frac{Vitamin\ B12\ bound\ by\ MMIP/MNIP}{Amount\ of\ MMIP\ or\ MNIP\ in\ per\ mL\ of\ solution}$$

$$\textbf{Imprinting Factor}\ (\textbf{IF}) = \frac{\mu g\ vitamin\ B12\ bound\ by\ per\ mg\ MMIP}{\mu g\ vitamin\ B12\ bound\ by\ per\ mg\ MNIP}$$

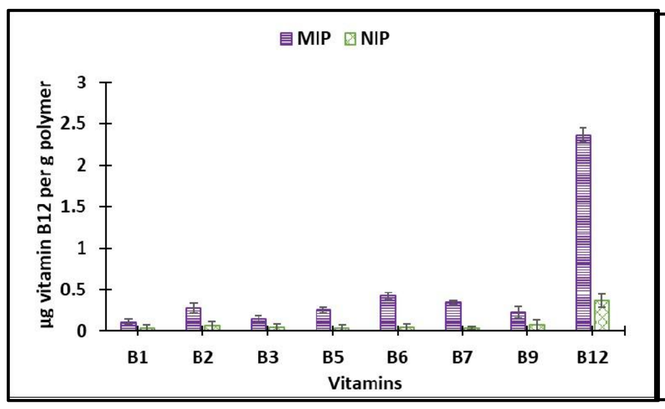
$$\textbf{Selective Adsorption ratio}\ (\textbf{SAR}) = \frac{(\mu g\ vitamin\ B12\ bound\ by\ per\ mg\ MMIP) - (\mu g\ vitamin\ B12\ bound\ by\ per\ r}{\mu g\ vitamin\ B12\ bound\ by\ per\ mg\ MMIP}$$

RESULTS & DISCUSSION

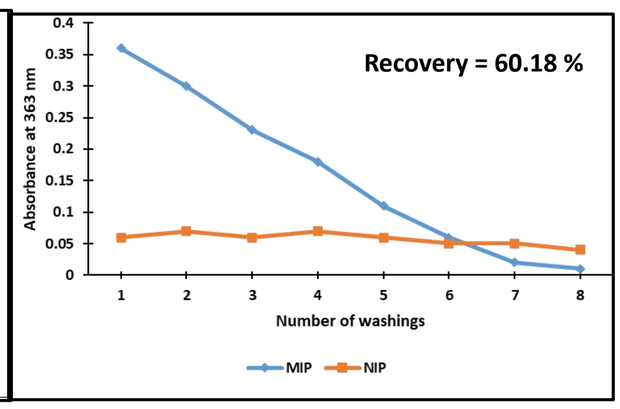
Imprinting Factor and Selective Adsorption Ratio after 24 h



- MMIP 4 (T: FM- 4; FM: C- 10; I: FM- 16) exhibited the highest binding capacity (2.4 ± 0.21 µg per mg polymer), good Imprinting factor (6.48) and good selectivity (84.58)
- Cross-reactivity from other B vitamins ranged from 2.30% for B1 to 8.43% for B6
- Influence of solvents and pH showed better selectivity in aqueous solutions at pH 6.5–7.0
- Recovery of 60.18% was obtained for milk system



Cross reactivity of MMIP/MNIP-4



Extraction of Vit B12 from milk

CONCLUSION

- Specific MIP was prepared for extraction of vitamin B12 from milk
- Ratios of components during MMIPs preparation significantly affect binding performance of MMIP with vitamin B12
- MMIP-4 had highest binding capacity, excellent selectivity with minimal interference

FUTURE WORK / REFERENCES

- Additional combinations needs to be explored to improve extraction efficiency from milk