

# Natural deep eutectic solvents as a green approach for extracting bioactive compounds from Moringa leaves

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## INTRODUCTION & AIM

Efforts are being made to valorize agroindustrial waste by recovering compounds of technological or functional interest using green extraction methods. Natural deep eutectic solvents (NADES) emerge as a versatile and sustainable alternative to traditional organic solvents.

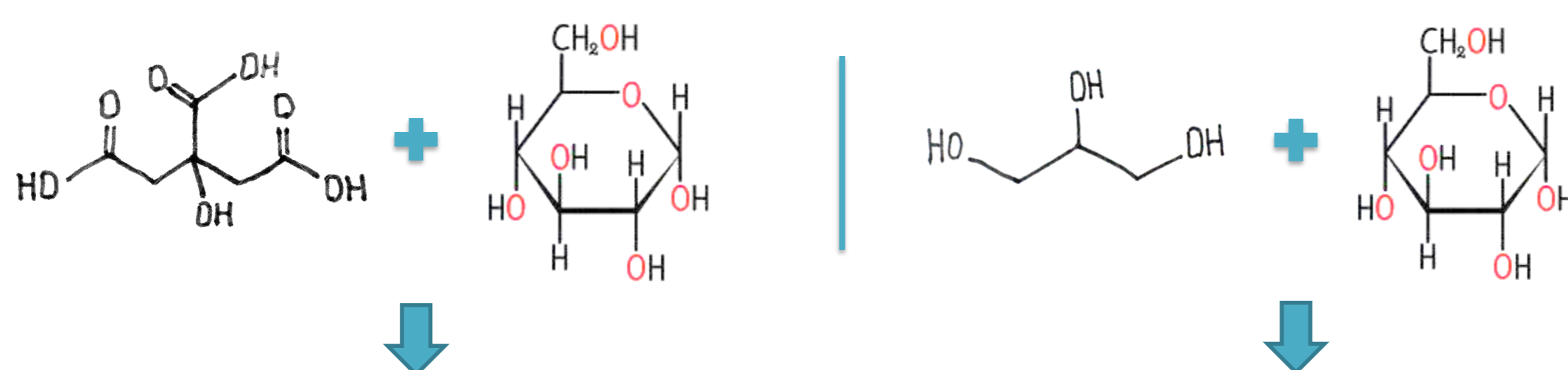
The objective of this work was the design of food-safe NADES to use as solvents to extract polyphenolic compounds from plant sources.

## METHOD

### OBTENTION AND CHARACTERIZATION OF NADES

CITRIC ACID:GLUCOSE (1:1)  
(CIT:GLU)

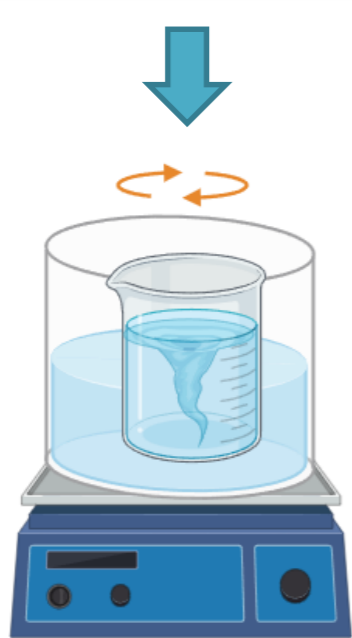
GLYCEROL:GLUCOSE (4:1)  
(GLY:GLU)



+ H<sub>2</sub>O (until 30% m/m)

Stirring and heating in a water bath

t = 90 min  
T = 60 °C



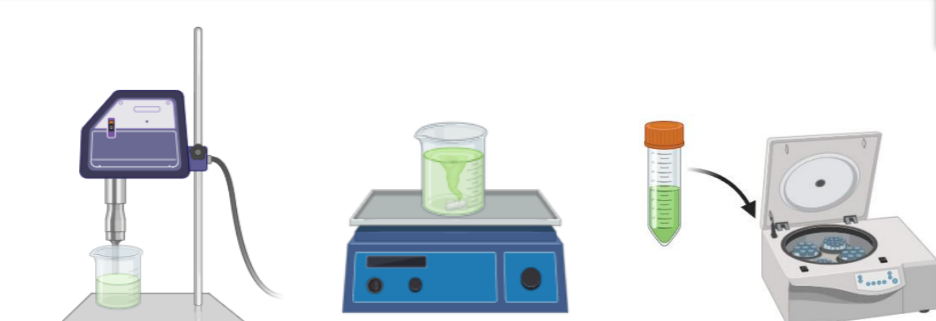
- ✓ density ( $\rho$ )
- ✓ refractive index ( $n_D$ )
- ✓ pH
- ✓  $a_w$
- ✓ conductivity ( $\sigma$ )
- ✓ polarity ( $E_{NR}$ , kcal/mol)

### APPLICATION OF NADES

DRIED AND GROUND MORINGA LEAVES



### EXTRACTION



RATIO S/L 1:50  
ULTRASONICATION: 5 min  
STIRRING: 1 h  
CENTRIFUGATION: 15 min, 3000 rpm  
T = 25 °C

NATURAL EXTRACT

Determination of Total Polyphenolic Content (TPC) by Folin – Ciocalteu with Galic Acid (GA) as standard

## RESULTS & DISCUSSION

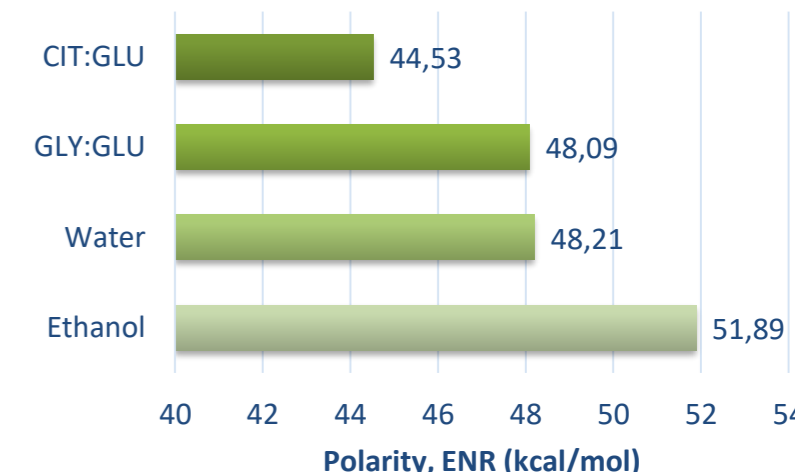
### PHYSICO-CHEMICAL CHARACTERISTICS OF THE NADES

NADES	CIT:GLU	GLY:GLU
$\rho$ (g/mL)	1,347 ± 0,000	1,251 ± 0,010
$n_D$	1,454 ± 0,000	1,420 ± 0,030
$a_w$	0,76 ± 0,00	0,67 ± 0,00
pH	0,68 ± 0,01	3,14 ± 0,01
$\sigma$ (mS/cm)	0,311 ± 0,000	0,001 ± 0,000

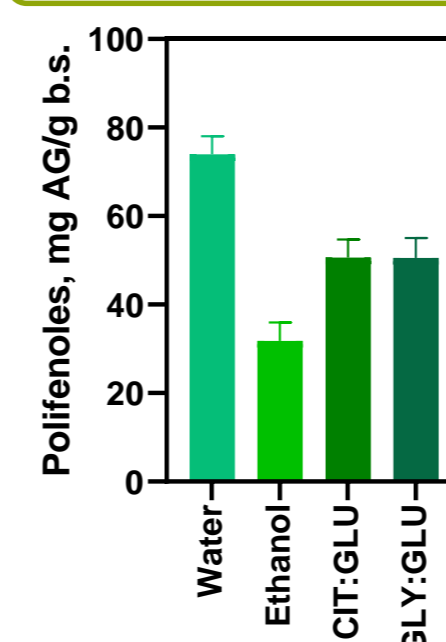
- Density of prepared NADESs: 1.238 and 1.382 g/mL, with systems CIT:GLU presented a higher density than GLY:GLU.
- Refractive indices ranged from 1.420 to 1.456 without significant differences ( $p < 0.05$ ) between the systems.
- The  $a_w$  of the CIT:GLU NADES was close to 0.75 and 0.66 for the GLY:GLU, suggesting a greater interaction between the components in this last system.
- The pH of NADESs with citric acid was less than 1.00 due to the high concentration of acid, while the pH in the GLY:GLU system was 3.13.
- Conductivity was 0.31 mS/cm in CIT:GLU due to the presence of citrate and null in the GLY:GLU, since its components do not form ions.

### POLARITY OF NADES

- Polarity was measured by mixing a solution of Nile Red with the solvent  $\rightarrow \lambda_{max}$  (nm) of absorption was determined and the  $E_{NR}$  parameter was calculated ( $E_{NR} = 28591 \text{ kcal.nm.mol}^{-1}/\lambda_{max}$ ). Higher polarity produces a bathochromic effect ( $\uparrow \lambda_{max}$  values and  $\downarrow E_{NR}$  values) and a hypsochromic shift in non-polar solvents<sup>1</sup>.
- The GLY:GLU systems presented a polarity similar to that of water and the CIT:GLU, had a greater polarity.
- Previous work indicates that NADES that have organic acids have greater polarity. The polarity of NADES with sugars is similar to that of water. NADES based on sugars and polyalcohols have polarity similar to that of ethanol<sup>2</sup>.



### POLYPHENOLS EXTRACTION WITH NADES



- The TPC of the extracts was between 40 and 50 mg GA/g b.s. The extraction yields were compared with ethanol, and better yields were obtained for the NADESs.
- The composition of the design solvent seems to be relevant, due to specific interactions that can be established between the NADES components and the compounds to be extracted.

## CONCLUSION

NADESs have the advantage of being natural, non-toxic, and could be designed with particular characteristics to favor extraction of specific compounds, and also to stabilize them during extraction and storage.

## FUTURE WORK / REFERENCES

<sup>1</sup>Dai, Y., van Spronsen, J., Witkamp, G.-J., Verpoorte, R., & Choi, Y. H. (2013). Natural deep eutectic solvents as new potential media for green technology. *Analytica Chimica Acta*, 766, 61-68.

<sup>2</sup>Farooq, M. Q., Muhammad, N., Atilhan, M., & Moniruzzaman, M. (2020). Deep eutectic solvents in separations: Methods of preparation, polarity, and applications in extractions and capillary electrochromatography. *Separation and Purification Technology*, 235, 116213.