Journal of the Serbian Chemical Society
JSCS@tmf.bg.ac.rs • www.shd.org.rs/JSCS
J. Serb. Chem. Soc. *89* (1) S52–S58 (2024) *Supplementary material*

SUPPLEMENTARY MATERIAL TO

Deep eutectic solvents formed by pharmaceutical ingredients and their potential influences on solid preparations

SARA TOUFOUKI[1], AHMAD ALI[1], YOUMO WANG[1], RUI LI[1], YU CAO[2]* and SHUN YAO[1]**

[1]*School of Chemical Engineering, Sichuan University, Chengdu, 610065, China and* [2]*College of Life Science & Biotechnology, Mianyang Normal University, Mianyang. 621000, China*

J. Serb. Chem. Soc. *89* (1) (2024) 107–121

Table S-I. VTF equation parameters of viscosity for the DESs.

DESs	A	B	T_0	R^2
DES 1	3029.339	0	0.003595	1.0000
DES 2	3181.367	0	0.003595	0.9995
DES 3	2651.201	0	0.003595	0.9999
DES 4	3215.718	0	0.003595	0.9996

Table S-II. Excess molar volume of the menthol-citric acid DESs (5-35 °C).

Temperature	Excess molar volume			
	DES 1	DES 2	DES 3	DES 4
5 °C	-334.788	-345.165	-344.859	-349.867
15 °C	-335.122	-345.343	-350.652	-350.007
25 °C	-339.043	-346.275	-353.392	-352.382
35 °C	-354.165	-347.174	-355.207	-359.605

Table S-3. Excess molar volume of the phenyl salicylate-benzoic acid DESs (35-55 °C).

Temperature	Excess molar volume	
	DES 12:1	DES 9:1
35°C	-283.749	-294.745
40°C	-284.868	-295.417
45°C	-285.253	-296.970
50°C	-285.567	-297.425
55°C	-286.202	-300.302

*,** Corresponding authors. E-mail: (*)cusack@scu.edu.cn, (**)agnes_cy2004@163.com

Table S-IV. Solubilities of the DESs in different solvents at room temperature*

DESs		Solubility of DESs				
		Water	Glycerin	Ethanol	Methanol	Acetone
menthol-citric acid	DES 1	PS	I	ES	ES	I
	DES 2	I	I	ES	ES	I
	DES 3	I	I	ES	ES	I
	DES 4	I	I	ES	ES	I
phenyl salicylate-benzoic acid	DES 12:1	I	I	ES	ES	I
	DES 9:1	I	I	ES	ES	I

*S: ES: easily soluble, I: insoluble and PS: poorly soluble

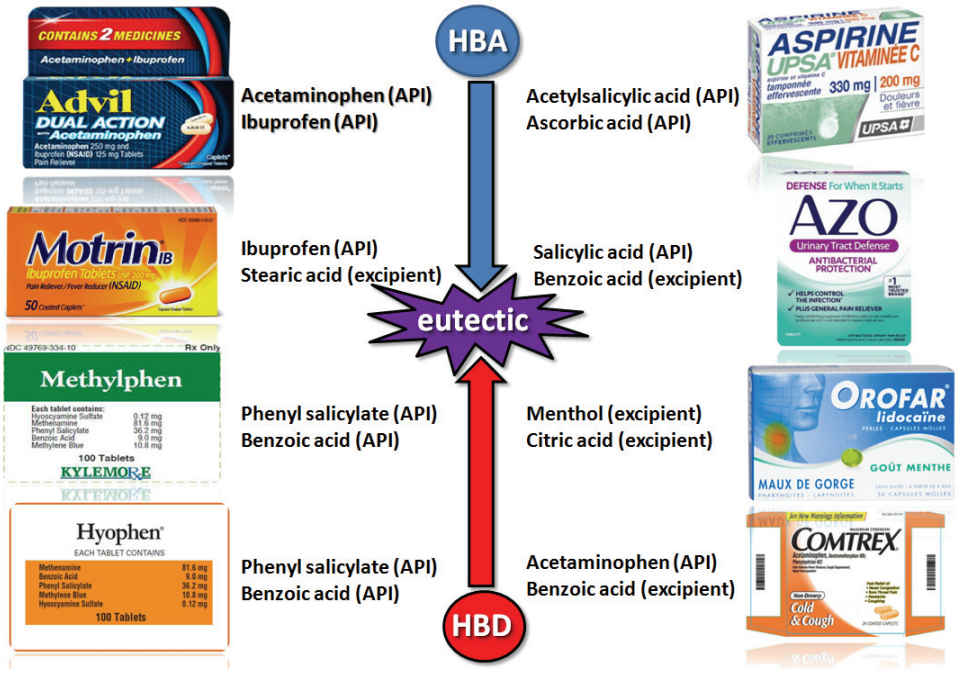

Fig. S-1. Common drug ingredients forming deep eutectic liquids.

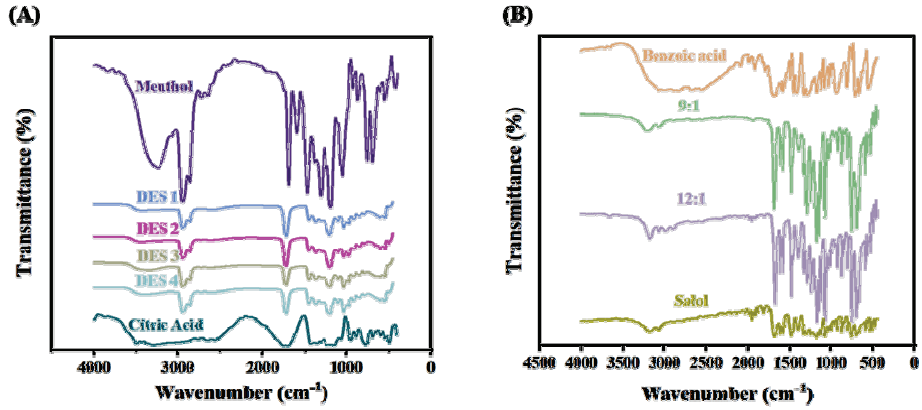

Fig. S-2. FTIR spectra of DESs composed of menthol and citric acid in various molar ratios (A); phenyl salicylate-benzoic acid DESs (B) and related pure components.

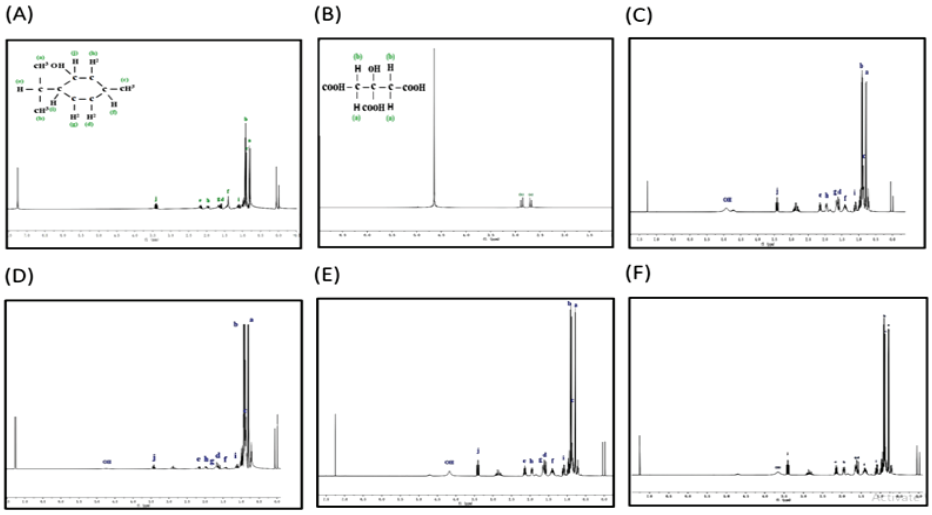

Fig. S-3. ^{1}H-NMR spectra (400 MHz, $CDCl_3$ for citric acid, DES 1-4 and D_2O for menthol) of (A) menthol, (B) citric Acid, (C) DES 1,(D) DES 2, (E) DES 3, and (F) DES 4.

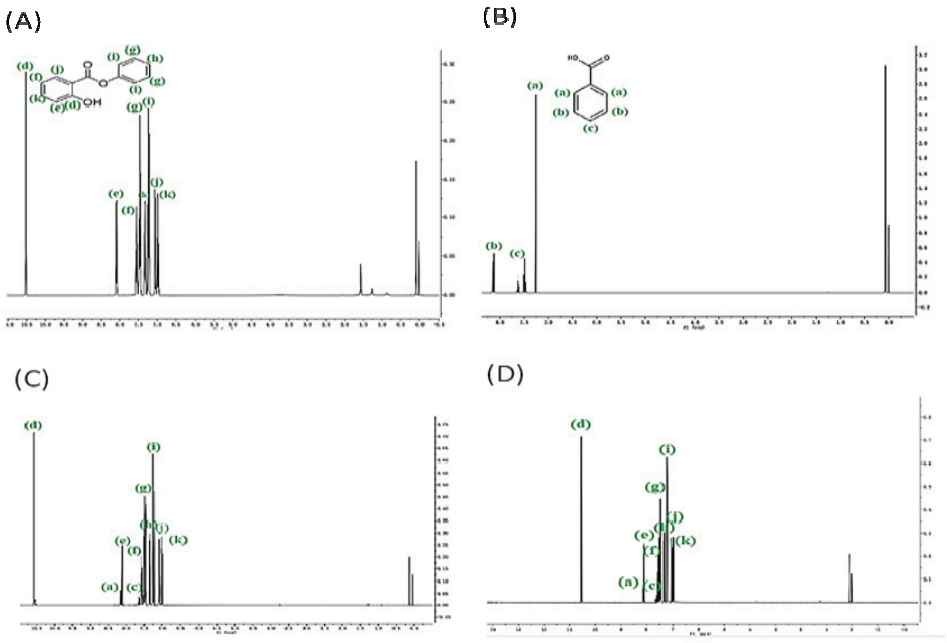

Fig. S-4. ^{1}H-NMR spectra (400 MHz, $CDCl_3$) of (A) phenyl salicylate, (B) benzoic acid, (C) their binary mixtures of 12:1 molar ratio, (D) binary mixtures of 9:1 molar ratio.

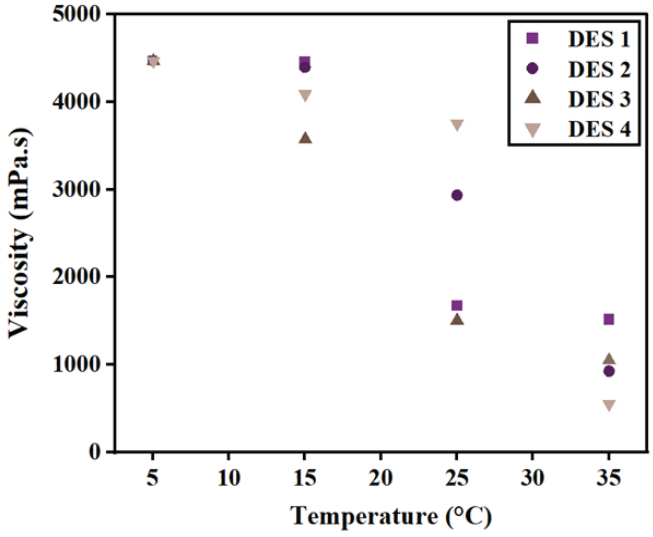

Fig. S-5. Plot of the predicted viscosity values of menthol-citric acid DESs.

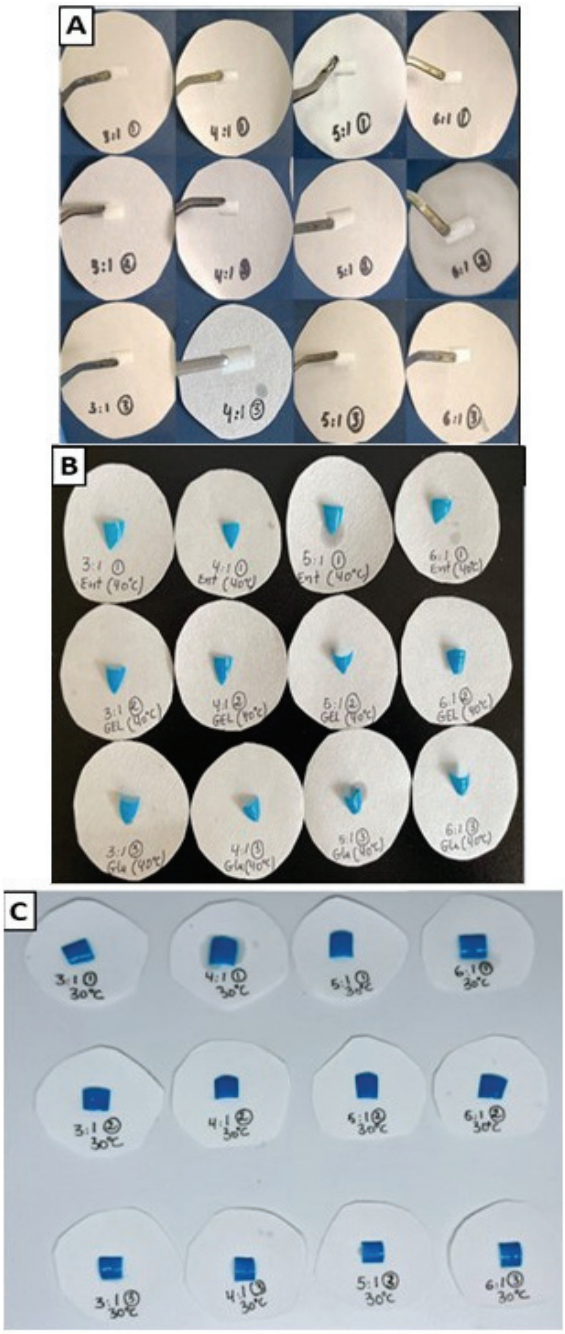

Fig.S-6. Photographs of the shells of enteric (1), gelatin (2) and glutinous (3) capsules taken after (A) 24 hours dissolved at 25°C;(B) 24 hours dissolved at 30°C; and (C) 24 hours dissolved at 40°C.

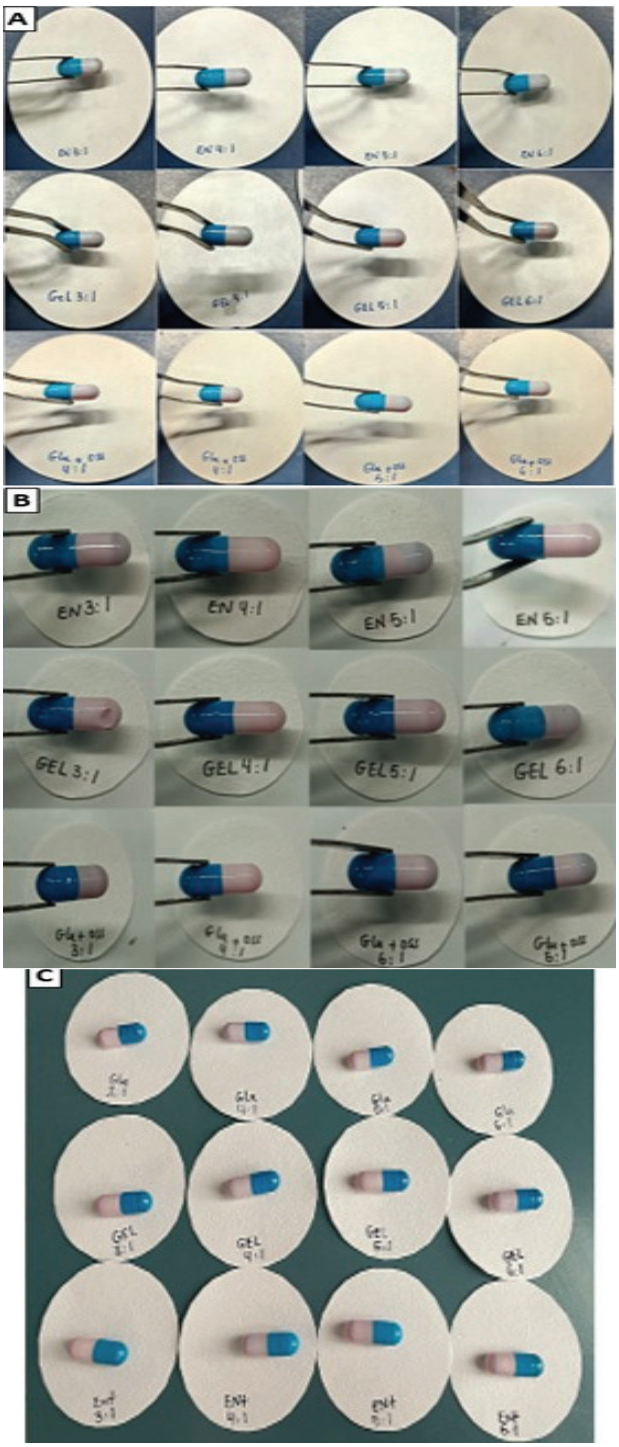

Fig. S-7. Photographs of enteric (Ent), gelatin (Gel) and glutinous capsules taken after 24 h filled with the tested DESs of different molar ratios at (A) 25 °C, (B) 30 °C, and (C) 40 °C.

REFERENCES

1. T. Zhang, J. Hu, S. Tang, *Chin. J. Chem. Eng.* **26** (2018) 1513 (https://doi.org/10.1016/j.cjche.2018.02.001)
2. D. Setyawan, D. Isadiartuti, S. D. Betari, D. P. Paramita, *Indones. J. Pharm.* **27** (2016) 28 (https://10.14499/indonesianjpharm27iss1pp28)
3. C. Coquelet, E. Auger, A. Valtz, *J. Solution Chem.* **48** (2019) 455 (https://10.1007/s10953-019-00870-6).