SUSTAINABLE AND ENVIRONMENTALLY FRIENDLY ISOLATION OF PHENOLIC ACIDS FROM NETTLE EXTRACT USING DEEP EUTECTIC SOLVENTS AND MACROPOROUS RESINS

Martina Jakovljević Kovač[1*] , Mario Komar[1] , Lidija Šoher[1] , Dragica Suknović[2] , Daniela Čačić Kenjerić[1] , Maja Molnar[1]

[1]University Josip Juraj Strossmayer of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[2]University Hospital Centre Osijek, Department of Clinical Laboratory Diagnostic, Josipa Hutlera 4, 31000 Osijek, Croatia

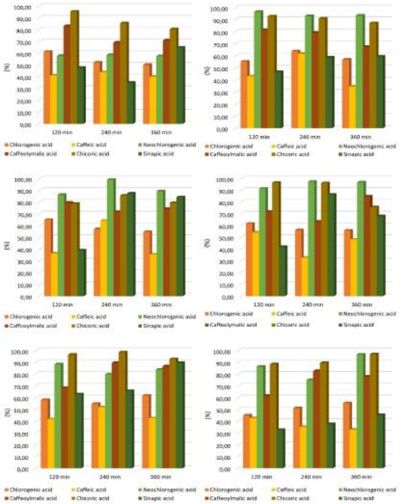
Introduction

The increasing awareness of the importance of using natural products leads to an increasing demand that needs to be met while maintaining the sustainability of the process itself. For the extraction and isolation of compounds from plant material that are increasingly used in the food and pharmaceutical industry, it is necessary to find sustainable, but also effective and selective methods of extraction and isolation. This is precisely why deep temperature eutectic solvents (DESs) and macroporous resins are increasingly used to obtain bioactive components from plant material, most often medicinal plants. One such plant is nettle (*Urtica dioica* L,), rich in antioxidant compounds, including phenolic acids, which show numerous positive health effects such as antioxidant, antibacterial, antiproliferative and anti-inflammatory. According to our previous research, the most suitable DES for the extraction of total phenolic acids (chlorogenic, caffeic, neochlorogenic, sinapic, chicoric, and caffeoylmalic acids) from nettle is choline chloride: lactic acid (1 : 2).

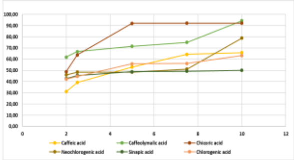
Methods and Materials

Powdered dried leaves of *Urtica dioica* L (50 mg) were mixed with 1 mL of the choline chloride: lactic acid (1 : 2) with 45 % water (*v/v*) and placed in bead mill homogenizer with bead speed of 5 m/s for 3.88 min. HPLC analyzes of phenolic acid were performed on an Agilent 1260 Infinity II. In order to isolate the components and purify the extract, static adsorption and desorption was carried out with five different resins and five different desorbents. After the adsorption process of the extract on the macroporous resin, the eutectic solvent was filtered and then subjected to distillation under reduced pressure to remove all residual water. The solvent was then prepared by adding the appropriate volume of water, depending on the optimal conditions for individual components, and was used again for further extraction.

Results



Picture 1. Effect of desorption time on the amount of phenolic acids from nettle extract in the desorbent (70% ethanol) using XAD7HP resin



Picture 2. Effect of desorbent volume on the amount of phenolic acids from nettle extract in the desorbent (70% ethanol) using XAD7HP resin

Table 1. Desorption capabilities of different resins used for optimal DES nettle extract

Resin	Desorbens	Desorption yield (%)					
		Caffeic acid	Chlorogenic acid	Neochlorogenic acid	Caffeoymalic acid	Sinapic acid	Chicoric acid
HP20	water	0.00	15.41±1.26	0,00	4.55±0.20	0.00	0.00
	30 % ethanol	10.77±0.67	39.39±0.17	60.34±0.46	29.92±0.81	0.00	0.00
	50 % ehtanol	26.09±0.32	49.04±0.82	60.19±1.01	48.48±0.77	0.00	0.00
	70 % ethanol	35.82±1.45	54.50±0.82	63.67±0.60	54.73±1.84	98.68±0.60	0.00
	ethanol	40.34±0.41	60.90±0.46	79.52±0.83	52.19±0.34	92.79±1.71	97.70±0.76
XAD7HP	water	0.00	8.39±0.77	66.81±0.15	0,00	0.00	0.00
	30 % ethanol	6.31±0.70	32.38±0.71	67.17±0,85	26.29±1.77	0.00	0.00
	50 % ethanol	40.35±0.90	54.96±0.25	68,.9±1.74	71.19±1.37	76.35±1.51	0.00
	70 % ethanol	57.28±0.27	53.31±0.42	81.56±1.01	79.08±1.07	0.00	0.00
	ethanol	70.09±0.79	49.45±1.21	86.07±1.81	75.29±1.80	0.00	0.00
XAD16N	water	0.00	14.19±0.89	0.00	3.94±1.36	0.00	0.00
	30 % ethanol	20.41±0.19	41.27±0.67	50.00±0.17	45.54±1.66	0.00	0.00
	50 % ethanol	32.16±0.36	57.53±0.54	53.78±1.84	64.93±0.91	0.00	0.00
	70 % ethanol	44.79±1.48	57.55±0.09	41.89±0.36	72.08±0.23	50.59±1.69	89.00±0.74
	ethanol	53.96±0.27	54.34±1.27	94.61±0.71	73.01±1.03	63.17±0.92	0.00
HP21	water	0.00	13.14±0.70	0.00	2.84±0.33	0.00	0.00
	30 % ethanol	30.11±0.33	46.70±1.07	53.99±0.13	41.38±0.22	0.00	90.78±1.20
	50 % ethanol	42.74±0.65	57.46±0.49	61.55±0.15	52.64±0.16	0.00	86.71±0.54
	70 % ethanol	47.63±1.71	60.31±1.48	91.59±0.62	62.90±0.51	98.37±1.48	95.56±1.99
	ethanol	47.48±0.24	60.05±1.06	99.80±1.38	68.42±1.76	0,00	93.64±0.76
HP2MG	water	0.00	4.80±0.42	0.00	0,00	0,00	0,00
	30 % ethanol	0.00	27.83±0.38	0.00	13.57±1.21	0,00	0,00
	50 % ethanol	39.88±1.51	48.05±1.70	83.22±1.78	66.43±0.64	0,00	76.85±1.87
	70 % ethanol	46.06±0.89	47.15±1.37	99.68±1.74	67.25±1.76	0,00	72.67±1.12
	ethanol	18.11±0.94	31.84±0.49	77.21±1.88	70.43±0.17	0,00	73.73±1.34

Table 2. Extraction efficiency for selected recycled DEs for phenolic acids from nettle extract

Resin	Number of cycles	Extraction efficiency (%)					
		Caffeic acid	Chlorogenic acid	Neochlorogenic acid	Caffeoymalic acid	Sinapic acid	Chicoric acid
XAD7HP	1	91.39±0.25	95.52±0.54	96.52±0.20	83.25±0.11	89.51±0.74	92.85±0.20
	2	85.54±0.43	85.68±0.44	86.35±0.03	79.56±0.58	68.09±0.25	89.60±0.93
	3	78.60±0.21	75.65±0.60	79.94±0.93	68.38±0.69	58.62±0.62	79.44±0.68