SEPARATION OF ACTIVE COMPOUNDS FROM TOBACCO WASTE USING SUBCRITICAL WATER

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Project ByProExtract

Material Tobacco waste

Extraction method SWE

Analysis HPLC

Optimization RSM

INTRODUCTION

Industrial processing of tobacco generates large amounts of waste. Tobacco waste have high nicotine content. It also has a high content of solanesol and are rich in other alkaloids and phenolic compounds. Therefore, final disposal of tobacco waste in the environment is difficult.
Re-using in the industry is suggested to limit their harm to the environment. This study evaluated subcritical water extraction (SWE) of bioactive compounds from tobacco waste (scrap, dust and midrib) obtained from tobacco processing factory "Fabrika duhana Sarajevo".
Recently, SWE has become a popular green extraction technique for the extraction of different classes of bioactive compounds from plant materials.

Fig. 1. a) Tobacco leaf b) dust c) midrib d) scrap

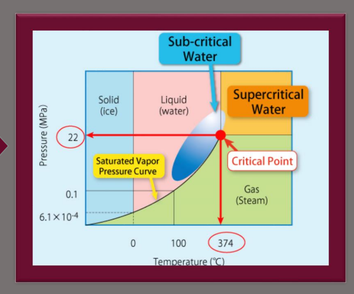
OBJECTIVES

(a) to separate valuable compounds from tobacco waste by applying sustainable green separation process—subcritical water extraction (SWE);
(b) identification and quantification of active compounds in obtained extracts using HPLC.
(c) determination of optimal conditions for SWE of active compounds.

METHODS

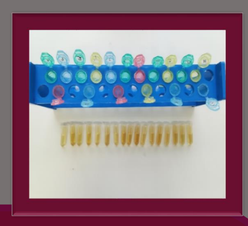
Box-Behnken design

Run	Temp. (X_1), °C	Time (X_2), min	Solvent-solid ratio (X_3), mL/g
1	150 (-1)	5 (-1)	20 (0)
2	250 (1)	5 (-1)	20 (0)
3	150 (-1)	25 (1)	20 (0)
4	250 (1)	25 (1)	20 (0)
5	150 (-1)	15 (0)	10 (-1)
6	250 (1)	15 (0)	10 (-1)
7	150 (-1)	15 (0)	30 (1)
8	250 (1)	15 (0)	30 (1)
9	200 (0)	5 (-1)	10 (-1)
10	200 (0)	25 (1)	10 (-1)
11	200 (0)	5 (-1)	30 (1)
12	200 (0)	25 (1)	30 (1)
13	200 (0)	15 (0)	20 (0)
14	200 (0)	15 (0)	20 (0)
15	200 (0)	15 (0)	20 (0)
16	200 (0)	15 (0)	20 (0)
17	200 (0)	15 (0)	20 (0)



SWE

EXTRACTS



HPLC ANALYSIS

Run	5-HMF (%)				Furfural (%)				5-MF (%)				3,4-DHBA (%)				Chlorogenic acid (%)				Rutin (%)				Nicotine (%)				Nicotinic acid (%)				Nicotinamide (%)			
	leaves	scrap	dust	midrib	leaves	scrap	dust	midrib	leaves	scrap	dust	midrib	leaves	scrap	dust	midrib	leaves	scrap	dust	midrib	leaves	scrap	dust	midrib	leaves	scrap	dust	midrib	leaves	scrap	dust	midrib	leaves	scrap	dust	midrib
1	0.06	0.03	0.02	0.04	0.06	0.08	0.08	0.06	0.05	0.03	0.03	0.04	**0.12**	0.17	0.16	0.11	1.52	0.50	0.29	0.12	2.3	0.86	0.69	0.11	1.97	2.66	1.50	0.907	0.08	0.17	0.15	0.08	0.13	0.24	0.21	0.10
2	1.45	0.07	0.05	0.21	0.61	0.15	0.12	0.22	0.33	0.14	0.10	0.19	**0.86**	1.01	0.63	0.64	0.09	0.09	0.05	0.07	0	0	0	0	4.31	4.43	2.28	1.97	0.53	0.66	0.30	0.54	0.46	0.39	0.25	0.31
3	0.29	0.04	0.03	0.08	0.14	0.10	0.09	0.07	0.05	0.07	0.06	0.05	**0.25**	0.35	0.21	0.23	1.36	0.41	0.22	0.09	2.08	0.69	0.47	0.10	2.15	4.61	2.31	1.23	0.10	0.31	0.63	0.12	0.14	0.36	0.21	0.11
4	0.26	0.03	0.03	0.05	0.19	0.12	0.10	0.12	0.22	0.10	0.09	0.11	**0.51**	0.74	0.62	0.36	0.08	0.06	0.05	0.06	0	0	0	0	3.64	2.99	1.8	1.02	0.51	0.48	0.42	0.38	0.38	0.38	0.29	0.17
5	0.16	0.03	0.03	0.04	0.03	0.06	0.05	0.04	0.02	0.03	0.03	0.03	**0.13**	0.21	0.17	0.20	1.09	0.41	0.30	0.10	1.46	0.78	0.55	0.13	1.89	3.35	2.72	1.30	0.07	0.22	0.17	0.14	0.09	0.25	0.21	0.09
6	0.75	0.04	0.04	0.09	0.21	0.09	0.07	0.07	0.14	0.07	0.07	0.12	**0.52**	1.24	0.79	0.52	0.05	0.07	0.03	0.04	0	0	0	0	3.9	5.14	2.75	1.77	0.50	0.84	0.48	0.60	0.30	0.38	0.24	0.20
7	0.13	0.03	0.03	0.06	0.06	0.09	0.09	0.07	0.04	0.06	0.06	0.05	**0.18**	0.25	0.20	0.17	1.27	0.45	0.26	0.11	2.14	0.87	0.54	0.12	1.94	3.25	2.15	1.10	0.08	0.23	0.15	0.09	0.13	0.29	0.21	0.11
8	0.80	0.04	0.05	0.13	0.28	0.14	0.15	0.16	0.24	0.13	0.12	0.16	**0.49**	0.95	0.92	0.55	0.07	0.09	0.11	0.07	0	0	0	0	3.28	4.24	3.22	1.71	0.38	0.62	0.51	0.52	0.31	0.40	0.36	0.25
9	1.05	0.07	0.06	0.15	0.19	0.08	0.08	0.16	0.12	0.10	0.10	0.14	**0.30**	0.42	0.36	0.33	0.93	0.42	0.19	0.07	0.37	0.25	0.10	0.03	2.33	4.05	2.43	1.48	0.16	0.45	0.27	0.28	0.11	0.28	0.18	0.11
10	1.51	0.07	0.07	0.29	0.32	0.09	0.08	0.28	0.27	0.11	0.11	0.19	**0.46**	0.70	0.49	0.52	0.39	0.10	0.05	0.07	0	0	0	0	2.85	4.25	2.95	1.57	0.27	0.51	0.31	0.41	0.14	0.31	0.17	0.13
11	1.12	0.05	0.05	0.26	0.19	0.10	0.10	0.14	0.15	0.09	0.10	0.12	**0.30**	0.34	0.32	0.31	1.05	0.39	0.17	0.11	0.57	0.40	0.23	0.07	2.16	3.06	2.17	1.25	0.14	0.31	0.21	0.19	0.13	0.25	0.20	0.13
12	2.29	0.10	0.08	0.36	0.50	0.14	0.12	0.31	0.33	0.17	0.15	0.24	**0.53**	0.67	0.43	0.53	0.52	0.21	0.11	0.10	0	0	0	0	2.65	3.94	2.36	1.47	0.24	0.47	0.24	0.32	0.23	0.35	0.20	0.17
13	1.65	0.06	0.08	0.27	0.36	0.12	0.15	0.29	0.23	0.13	0.15	0.21	**0.42**	0.51	0.52	0.41	0.73	0.30	0.13	0.09	0.11	0.07	0.03	0	2.56	3.2	2.69	1.30	0.23	0.36	0.31	0.28	0.16	0.26	0.25	0.16
14	1.93	0.09	0.08	0.31	0.42	0.14	0.15	0.30	0.29	0.15	0.15	0.22	**0.49**	0.55	0.52	0.50	0.72	0.24	0.14	0.11	0.08	0.06	0.03	0	2.72	3.71	2.80	1.52	0.24	0.43	0.32	0.33	0.19	0.30	0.26	0.18
15	1.92	0.08	0.08	0.25	0.36	0.13	0.14	0.42	0.25	0.14	0.14	0.20	**0.45**	0.51	0.51	0.44	0.65	0.25	0.14	0.09	0.06	0.12	0.02	0	2.57	3.24	2.64	1.33	0.21	0.37	0.31	0.30	0.17	0.27	0.24	0.17
16	2.07	0.08	0.08	0.35	0.44	0.13	0.13	0.31	0.29	0.14	0.12	0.28	**0.49**	0.46	0.44	0.47	0.72	0.24	0.10	0.09	0.11	0.11	0.02	0	2.92	3.24	2.45	1.41	0.23	0.38	0.27	0.32	0.18	0.28	0.22	0.16
17	2.12	0.08	0.09	0.32	0.51	0.13	0.15	0.30	0.32	0.14	0.15	0.23	**0.50**	0.48	0.50	0.48	0.82	0.23	0.12	0.08	0.12	0.05	0.01	0	3.08	3.21	2.78	1.40	0.26	0.37	0.32	0.32	0.19	0.27	0.25	0.19

RESULTS

DESIRED COMPOUNDS

- Nicotine
- Nicotinic acid
- Nicotinamide
- Chlorogenic acid
- Rutin
- 3,4 DHBA

UNDESIRED COMPOUNDS

- furfural
- 5-HMF
- 5-MF

OPTIMAL CONDITIONS

Extraction parameters	Tobacco material			
	Leaves	Scrap	Dust	Midrib
Solvent-solid ratio (mL/g)	23	28	10	30
Temperature (°C)	160	150	160	150
Time (min)	25	23	20	25

CONCLUSION

Extracts were characterized with high level of nicotine, and considerable amounts of nicotinic acid, nicotinamide, 3,4 DHBA, chlorogenic acid and rutin, but sum undesirable compounds such as 5-hmf, furfural, 5-metilfurfural, as well.
Therefore, optimization of SWE process is inescapable step for large-scale application.