

Separation of bioactive compounds from tobacco waste using the sequence of supercritical CO₂ extraction and subcritical water extraction



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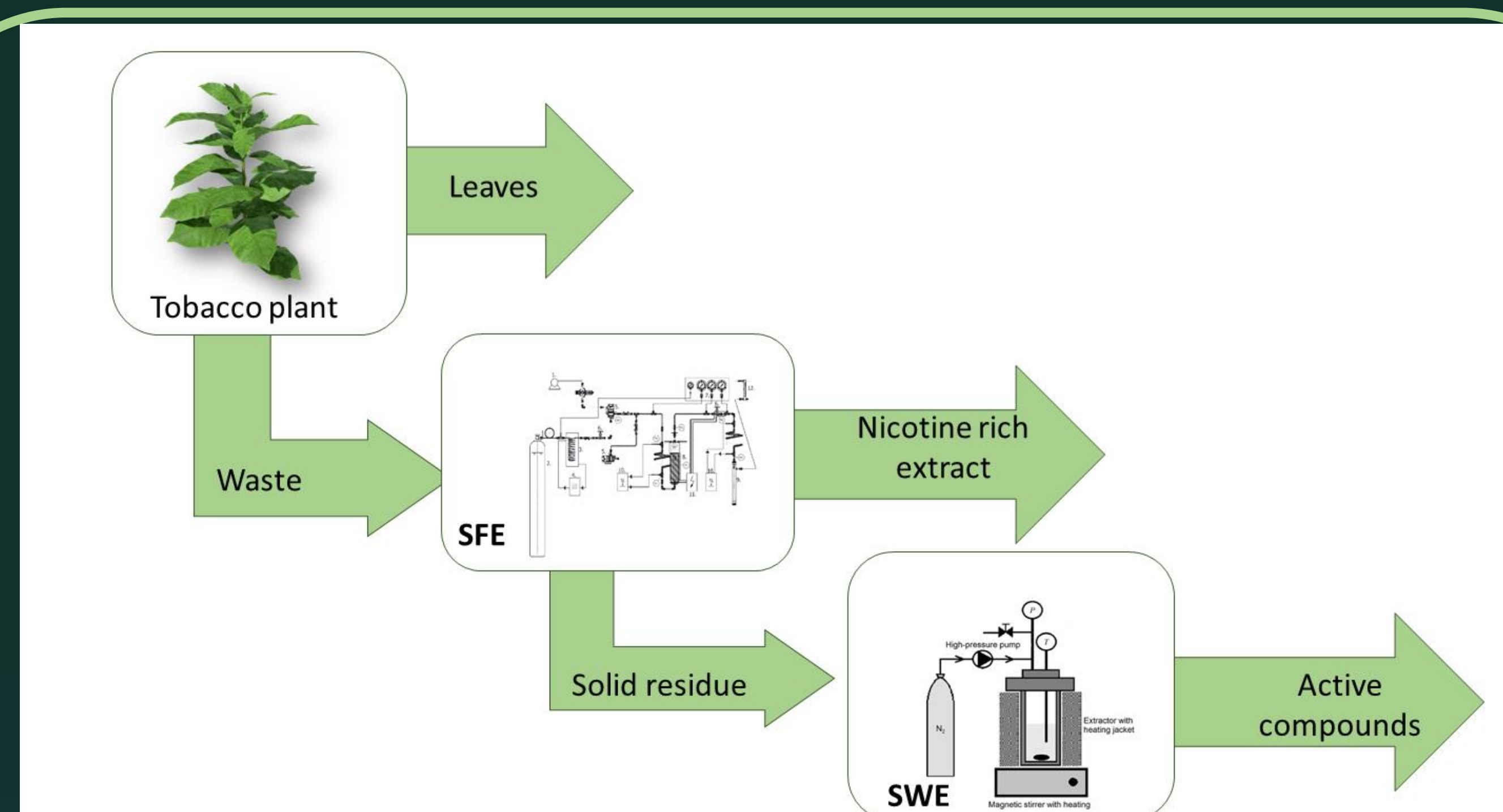
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INTRODUCTION

The food and plant industry generate large amounts of wastes or by-products annually around the world from a variety of sources. Improper management and illegal dumping of waste, particularly hazardous and toxic waste, possess increasing threats to the environment and human health. Tobacco waste is a by-products produced in large quantities during processing of tobacco and in most cases, represents an inefficient use of valuable compounds.

These type of waste can be used for production of reconstituted tobacco sheets and as a fuel but that utilization are less effective because of presence of high concentration of nicotine and reducing sugars. Furthermore, tobacco waste is a material rich in active compounds. This study, for the first time, evaluated supercritical fluid extraction (SFE) followed by subcritical water extraction (SWE) in order to extract active compounds from tobacco waste. Extraction of active compounds from tobacco waste is new opportunity for this type of material and its contribution to sustainable resource management.



RESULTS

Table 1: Nicotine content in extracts obtained by SFE

RUN	Pressure (bar)	Temperature (°C)	Nicotine (%)
1	200.00	60.00	5.740
2	300.00	60.00	3.620
3	200.00	60.00	4.280
4	300.00	40.00	9.371
5	200.00	40.00	9.034
6	200.00	60.00	7.964
7	300.00	80.00	7.621
8	100.00	80.00	6.763
9	100.00	40.00	8.311
10	200.00	60.00	15.85
11	200.00	80.00	14.43
12	200.00	60.00	11.52
13	100.00	60.00	9.711

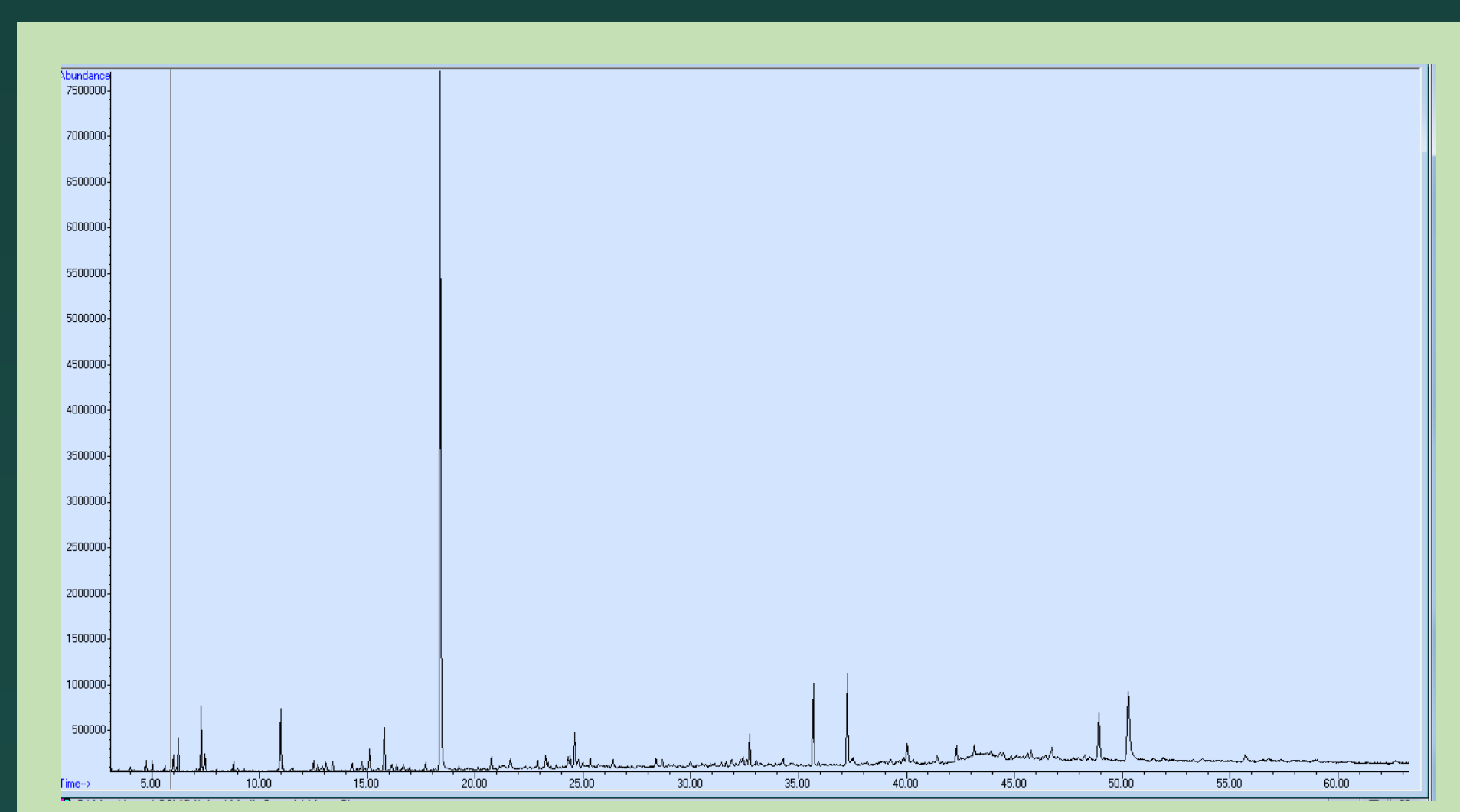


Figure 1: GC-MS Chromatogram of detected nicotine in SFE extract, run 9



Figure 2: Comparison of nicotine content in SFE and SWE extract

MATERIALS AND METHODS

Tobacco waste (type: scrap) in this study was obtained from “Fabrika Duhana Sarajevo” from Bosnia and Herzegovina. A series of operational parameters of supercritical CO₂ (SC-CO₂) extraction of tobacco waste (pressure: 100–300 bar, temperature: 40–80 °C), were investigated in a laboratory scale apparatus in order to get extracts rich in nicotine. The CO₂ mass flow rate was kept constant during the process. From reused tobacco waste (after SC-CO₂ extraction), subcritical water extraction (SWE) under selected conditions (solvent/solid ratio: 28 mL/g, temperature: 150 °C, time: 23 min) was sequentially performed to obtain the extracts rich in phenolic compounds. The content of bioactive compounds was determined using High Performance Liquid Chromatography (HPLC) and by gas chromatography (GC-MS).

Table 2: Active compounds content in extracts obtained by SWE

RUN	Nicotin (%)	Nicotinic acid (%)	Nicotinamid (%)	5-HMF (%)	Furfural (%)	5-MF (%)	Chlorogenic acid (%)	3,4-DHBA (%)	Rutin (%)	Neochlorogenic acid (%)
1	2.526	0.129	0.218	0.042	0.371	0.022	0.386	0.154	0.000	0.289
2	2.494	0.110	0.220	0.058	0.377	0.022	0.376	0.210	0.571	0.274
3	2.343	0.112	0.219	0.052	0.371	0.023	0.352	0.185	0.511	0.236
4	2.251	0.117	0.224	0.050	0.388	0.023	0.388	0.212	0.489	0.257
5	1.683	0.110	0.186	0.029	0.356	0.021	0.389	0.138	0.000	0.225
6	2.056	0.097	0.206	0.060	0.388	0.022	0.379	0.191	0.579	0.257
7	1.814	0.098	0.185	0.043	0.369	0.022	0.358	0.182	0.000	0.237
8	1.592	0.084	0.173	0.047	0.366	0.021	0.193	0.166	0.000	0.217
9	1.573	0.084	0.166	0.050	0.359	0.021	0.324	0.168	0.000	0.210
10	1.388	0.088	0.170	0.050	0.357	0.021	0.301	0.155	0.000	0.180
11	1.707	0.083	0.177	0.047	0.370	0.021	0.404	0.162	0.505	0.192
12	1.063	0.080	0.165	0.060	0.365	0.021	0.297	0.159	0.557	0.182
13	1.195	0.088	0.147	0.061	0.378	0.022	0.365	0.220	0.000	0.177

CONCLUSION

Obtained extracts of tobacco waste after SC-CO₂ extraction were characterized by high levels of nicotine, and after SWE extracts were characterized by a high content of phenolic compounds (chlorogenic acid, neochlorogenic acid and rutin), considerable amounts of nicotinic acid and nicotinamide and reduced content of nicotine. Also, presence of 5-HMF, furfural and 5-MF was detected in SWE extracts.

Acknowledgments

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